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SAFETY AND SECURITY OF SPENT NUCLEAR FUEL TRANSPORTATION

HEARING

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

SEPTEMBER 24, 2008

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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

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CONTENTS

SAFETY AND SECURITY OF SPENT NUCLEAR FUEL TRANSPORTATION

WEDNESDAY, SEPTEMBER 24, 2008

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Committee met, pursuant to notice, at 2:03 p.m., in room SR–253, Russell Senate Office Building, Hon. Daniel K. Inouye, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. DANIEL K. INOUYE, U.S. SENATOR FROM HAWAII

The CHAIRMAN. Accomplishing the safe and secure transportation of nuclear waste is one of the more complex challenges facing our government. Spent nuclear fuel is the byproduct of the nuclear power industry that supplies electric energy to millions across the country and also is created by our armed forces. This fuel retains its radioactive qualities for thousands of years and is currently stored at 77 commercial and government sites across the country.

We are not here to discuss the merits of the Department of Energy's selection of Yucca Mountain, Nevada as a site for a permanent underground geological repository to store nuclear waste or its current license application. Rather, we must ensure that all shipments of spent nuclear fuel and high-level waste are held to the highest safety and security standards.

Today nuclear waste is transported by rail, truck, and barge, all of which are under the jurisdiction of this Committee, and the risks of transporting nuclear waste must be fully understood and evaluated and a system of transportation must be designed to fully address these risks.

In this hearing, we will examine the current regulatory regime for nuclear waste transportation and hear from researchers and a representative of the rail industry in order to more fully understand the challenges of transporting nuclear waste. It is this Committee's obligation to evaluate these challenges and to ensure that spent nuclear fuel and high-level radioactive waste is transported in ways that minimize the safety and security risks to the general public.

With that, may I first welcome the delegation from Nevada, but I will call upon Senator Ensign. Afterwards he will come up here. Senator Ensign?

STATEMENT OF HON. JOHN ENSIGN,
U.S. SENATOR FROM NEVADA

Senator ENSIGN. Mr. Chairman, thank you very much for holding this hearing. As you know, the Nevada delegation has been unified as Nevadans, as most Nevadans are in opposition to the Yucca Mountain project, and part of that project is the whole idea of transporting nuclear waste. I realize that that is what this hearing is about today, but we also need to educate Americans what this means—where is this nuclear waste going to be transported, and what are the parameters in studying how safe this nuclear waste is to transport.

But we also have to look at the costs associated. I remember a few years ago, Senator Reid and I saying when the cost estimates, about 5 years ago, for Yucca Mountain were about the mid-$50 million range, and Senator Reid and I testified that the cost is going to go at least to $100 billion, and probably north of $100 billion would be the cost of Yucca Mountain. People kind of said, no, that is not right. Those are way over estimate. Well, now the most recent cost estimate for Yucca Mountain is $96 billion.

What a lot of people do not realize, especially those who want to get the nuclear waste out of their state, which then leads to the transportation, is Yucca Mountain, the way it is currently being constructed, will only handle the nuclear waste that has been produced by this country up to this point. It does not handle any nuclear waste that this country will be producing into the future.

And so I think that while we are studying transportation issues and talking about the transportation issues, we should also look at whether we need to transport it at this point. We need to look at other technologies that other countries are doing, like France, and the amount and how they transport their waste, but also what they do with their waste. Basically they recycle their waste, and they have a lot smaller volume.

But we also have to tell the American people, who have nuclear powerplants in their state that think that they are getting rid of all of their nuclear waste, that that in fact is not the case. I remember when Spence Abraham was the Secretary of Energy and he came and he was talking about—this was right after 9/11—and the safety, that we need one repository. So we bring all the nuclear waste to one repository.

Well, the fact is that when you have a spent nuclear fuel rod, it needs to cool for several years in cooling pools before you can actually transport it, before you could take it to a repository, if that is, indeed, what you wanted to do. So there is going to be nuclear waste or partially spent nuclear fuel rods all over the country.

Those are just some of the issues I believe that are important to talk to the American people and to be honest with the American people. Is this a policy that we should continue? I do not believe it is. I believe that we should catch up with the rest of the world on some of the modern recycling technologies, and in doing so, we can address the transportation issues. But we should be honest with the American people what the transportation issues are, where those transportation routes are and be honest with them and look at other countries and what they have done with it.

But we also, in light of that, need to look at whether or not Yucca Mountain is the place that we want to take very valuable fuel, whether we want to look at onsite dry cask storage, which is good for 100 to 200 years, which, by the way, would obviate the need for transporting nuclear waste, and then we should look at the recycling efforts as well.

So I have a formal statement and would ask that that be made part of the record.

But, Mr. Chairman, I appreciate you holding this hearing today and listening to two concerned Nevadans who happen to represent a lot of other Nevadans on this important issue to our state.

[The prepared statement of Senator Ensign follows:]

PREPARED STATEMENT OF HON. JOHN ENSIGN, U.S. SENATOR FROM NEVADA

Mr. Chairman, I would like to thank you for the opportunity to testify today on behalf of the people of Nevada.

Mr. Chairman, I would like to be clear: Yucca Mountain is not an issue that affects just the residents of Nevada—it is an issue that affects every American. I am here today to explain that the plan to store spent nuclear fuel at Yucca Mountain is not a solution. The storage of spent nuclear fuel at Yucca Mountain is a plan plagued by unrealistic assumptions about cost, poor transportation and waste management planning, and insufficient scientific testing to ensure the safety of our communities. I believe that we can do better.

I have bad news for those of you with working nuclear reactors in your states who think that the opening of Yucca will rid your state of nuclear waste—you're wrong. You see, even if it were possible to immediately and magically remove all of the existing spent fuel from commercial nuclear power plant locations, there would still continue to be spent fuel stored at each and every operating reactor in the country. That's because nuclear waste is highly radioactive and thermally hot and must be kept at the reactor sites in water-filled cooling pools for at least 5 years. The only way spent fuel storage can be eliminated from a reactor location is to shut down the reactor. And that isn't an option.

Mr. Chairman, let's also consider the long-range cost of Yucca Mountain. The most recent estimates of the cost of Yucca Mountain are nearing $100 billion—and I am pretty certain it will go higher. What do we get for our money? The same problem we have today. We will have 65,000 metric tons of commercial nuclear waste by the time Yucca Mountain is scheduled to open. We produce 2,000 metric tons of nuclear waste a year. The DOE plans to transport 3,000 metric tons a year. Just do the math. We won't get rid of the nuclear waste backlog for nearly a century and Yucca Mountain will be filled long before then.

And under the Department of Energy's plan, there is no requirement for the oldest and most thermally cool, spent fuel to be shipped first. Without this sort of requirement, nuclear facilities will have the incentive to ship out more recently spent fuel that is hotter and more dangerous to transport. Unfortunately, this is just another hole in DOE's plan for Yucca Mountain.

And Mr. Chairman, the NRC hasn't even conducted full-scale physical tests on actual spent fuel casks. I wouldn't put my children in a car that hadn't been crash tested, but I'm supposed to put them on a highway next to a truck with casks of nuclear waste that haven't been adequately tested. In fact, experts from the National Research Council have examined this issue and strongly endorse the use of full-scale testing to determine how packages will respond to real-world conditions.

These casks are going to be traveling by homes, schools, and churches. And at this time we can't be sure they will survive real-world conditions. For example, the casks have not been tested in fully engulfing long-duration fires. The testing is for 30 minutes at 1475 degrees Fahrenheit. The temperature in the Baltimore tunnel fire reached 1500 degrees Fahrenheit, and the fire burned for hours.

It doesn't seem to me that the proponents of the Yucca Mountain have done enough to prove that the plan is safe, and the entire Nevada delegation has concerns. To address this, the Nevada Congressional delegation will be sending a letter to the Surface Transportation Board outlining our concerns regarding the construction and operation of a rail line from eastern Nevada to the proposed nuclear waste repository at Yucca Mountain.

So if Yucca Mountain isn't the answer, what is?

Mr. Chairman, we should keep that waste right where it is, safely stored for the time being. The Federal Government should offer to take title and liability to the waste stored on site, just as it did in Pennsylvania under the PECO settlement. The NRC has stated fuel can be stored safely on site for at least 100 years in dry cask storage. That leaves plenty of time to continue to develop new technologies at our National Labs to recycle the waste without producing weapons-grade plutonium as a byproduct.

I believe that we need to do what this country does best: innovate and lead the world in cutting edge technologies. Unfortunately, with Yucca Mountain, we have been way behind the curve on how we manage our spent nuclear fuel. For instance, the French store their spent fuel byproducts in above-ground repositories—this model seems to make more sense for a country as large as ours. It seems to me that we should be using $100 billion in Yucca funding to develop new recycling technologies and make a dent in the challenge of managing spent fuel.

And managing spent nuclear fuel is a serious challenge we face. As a legislator, like all of you, I need to be fully informed about the effects of legislation on my constituents before I vote. I know that Yucca Mountain will be bad for both the people of Nevada and the United States. It comes down to this: you are being asked to risk the health and safety of your constituents for a scheme that will leave this country looking for another nuclear waste storage site 24 years after Yucca Mountain opens. It's just not worth it.

The CHAIRMAN. I thank you very much, Senator, and your statement will be made part of the record. If you will join me.

Now it is my pleasure to present a most distinguished American, the Leader of the Democratic majority in the U.S. Senate, the Honorable Harry Reid.

STATEMENT OF HON. HARRY REID,
U.S. SENATOR FROM NEVADA

Senator REID. Mr. Chairman, thank you very, very much. I very much appreciate you chairing this meeting. Your service to the country is well known and being Chairman of this most important Committee is also part of your legacy.

Senator Ensign and I are speaking for Nevadans, but we are also speaking for people all over this country. And there will be testimony today by those on Panel II that will talk about the dangers to the American people outside Nevada of transporting the most poisonous substance known to man.

We have not looked at this for some time, the issue of nuclear waste. I have said and I believe without any question that Yucca Mountain is dead. The money being spent on it is a big waste of taxpayers' dollars.

Now, this is a busy week, but this hearing is necessary because the Nuclear Regulatory Commission has just docketed the Department of Energy's application to be in construction at Yucca Mountain.

Like its application, the Department of Energy's nuclear waste shipping plans are grossly—grossly—incomplete. Yet, the Department wants to spend over $3 billion to start building a 300-mile radioactive railway through Nevada. They want to do this before they even have permission to build the dump. Anything to divert attention from the dump is what they are involved in.

It amazes me and people who have watched this Yucca Mountain project since the early 1980s how long the Department of Energy has pushed this Yucca project with having no transportation plan in place. They have not made public its proposed shipping routes. They have not finalized the national transportation plan. Their

draft transportation plan is barely a crude sketch of the comprehensive planning that should actually be done for a massive nuclear waste shipping program.

Equally shocking is that the transportation of aging disposal casks the Department of Energy plans to use have not been designed yet. The Department says that 90 percent of the nuclear waste will be shipped using these transportation storage canisters, but they have absolutely no reason to believe that this is true. There is no guarantee that nuclear utilities are actually willing to pay for these canisters, especially those that already use dry cask storage to securely store their waste.

Not from here is the Calvert Hills nuclear generating facility. They have for years stored the stuff onsite, saving millions and millions of dollars, and certainly it is safe.

After 9/11, the thought of shipping this poisonous substance on highways and railways across the country is at the very least very scary. But these untested, yet-to-be-designed canisters are part of the foundation of the Yucca plan. The key defense against a transportation disaster—one of the Department of Energy's primary barriers against radioactive leakage from the nuclear waste dump. But that is not important to the Department now because the Nuclear Regulatory Commission has made the decision that the Department of Energy's license application for Yucca was complete.

In order to get all the nation's nuclear waste at Yucca, the Energy Department is proposing between 3,000 and 11,000 rail shipments and as many as 10,000 truck shipments twice a week for the next 24 years. Trains loaded with this substance would traverse the country traveling to Nevada. Some of the distances would be as much as 3,000 miles. Many of these shipments would go right by the world's destination resort, Las Vegas, the Strip. Trains would pass within a half mile of hundreds of thousands of visitors on any given day to Las Vegas that hosts tens of thousands of workers.

Texas could host up to 308 nuclear waste shipments alone. All these shipments would go through Arizona communities just from Texas, collecting even more waste perhaps even in Arizona.

The Department of Energy and nuclear industry lobbyists will tell you that the risk of accident is low. What they do not tell you is the risk is a relative risk. Let us say it is 98 percent successful, even 99 percent. That means there would be 5,000 botched surgeries each year. 99 percent gets us to 200,000 wrong drug prescriptions each year. 99 percent gets us to 20,000 lost pieces of mail each hour. The point is simple. More nuclear waste on the road will certainly involve more accidents. Accidents will happen. It is only a question of where and when. It will put the lives of millions of Americans at risk. So I would ask the Department not to be throwing around the 99 percent number because that is not valid in light of what could happen with that 1 percent.

One of the things I fear is that the Department of Energy is not going for 100 percent success. They are not even trying to eliminate the risk. One of the most glaring examples is their refusal to consider shipping the oldest, less radioactive nuclear waste first, a basic measure that could reduce radiological hazards by 85 percent.

The Members of the Committee should ask the Department of Energy and Nuclear Regulatory Commission and the Academy of Sciences about this issue. Both the Academy and the Government Accountability Office told the Energy Department that they should ship older nuclear waste first. The state of Nevada, which understands the risks, has urged the Department to consider shipping the oldest first. But the Department of Energy has made up its mind. The answer is no. It is not logical, but the answer is no.

The nuclear power industry wants to get rid of its more expensive and most radioactive waste first. The question is why has the Department of Energy not even considered shipping the oldest first. They do not mention it in their environmental analysis for transporting waste to Yucca. They do not consider it in their draft national transportation plan. It is unfortunate that the Department of Energy once again is refusing to let logic get in the way of building its waste dump at Yucca.

We all know that nuclear waste cannot be stored at Yucca safely, but it can be stored safely for a very long time in secure dry cask storage containers. If allowing nuclear waste to cool for 50 to 100 years improves the safety of shipping in the future, the Department should be seriously considering onsite storage, which they are not, even though scientists say it is the way to go. I say a majority of the scientists.

Storing waste at nuclear reactors not in the earthquake-prone Yucca Mountain would give us the time needed to develop secure, scientifically sound, long-term solutions for nuclear waste. Senator Ensign and I have been saying this from the beginning.

As Senator Ensign said, Yucca's price tag is now approaching $100 billion. This is $49 billion more than the Department of Energy's 2001 estimate. The cost of Yucca increases at a rate of $7 billion a year. The annual payments to the nuclear waste fund are only a fraction of how much Yucca's cost is increasing. The $22 billion nuclear waste fund will never ever come close to covering the price of Yucca. The taxpayer will be on the limb for that.

Terrible risks of transporting nuclear waste is yet another reason that this project is going to be stopped. That is why I appreciate very much the Appropriations Committee cutting back the money this year. It will be cut back at least $70 million from last year.

Mr. Chairman, let me finally say that there has been a lot of cheerleading recently because this matter has been sent to the Nuclear Regulatory Commission. Their information they sent is incomplete. They have nothing dealing with transportation. This is a hoax and it will never happen. Yucca Mountain will never come to be.

Could I be excused, Mr. Chairman?

[The prepared statement of Senator Reid follows:]

PREPARED STATEMENT OF HON. HARRY REID, U.S. SENATOR FROM NEVADA

I want to thank Chairman Inouye, Senator Hutchison, and the Members of the Committee for scheduling this important hearing. It has been a long time since the Senate has looked closely at plans to ship nuclear waste to Nevada.

This is a very busy week. But this hearing is necessary now because the Nuclear Regulatory Commission has just docketed the Department of Energy's application to begin construction at Yucca Mountain.

Like its application, the Department of Energy's nuclear waste shipping plans are grossly incomplete. Yet, the Department really wants to spend over $3 billion to start building a 300-mile radioactive railway through Nevada. They want to do this before they even have permission to build the dump.

It amazes me how long the Department of Energy has pushed the Yucca project without having a real transportation plan in place. The Department has not made public its proposed shipping routes, and they still haven't finalized their National Transportation Plan. Their draft transportation plan is barely a crude sketch of the comprehensive planning that should actually be done for a massive nuclear waste shipping campaign.

Equally shocking is that the Transportation Aging and Disposal casks the Department of Energy plans to use have not even been designed yet. The Department says that 90 percent of nuclear waste will be shipped using these transportation-storage canisters, but they have absolutely no reason to believe that this is true. There is no guarantee that nuclear utilities are actually willing to pay for these canisters, especially those that already use dry cask storage to securely store their waste.

Yet these untested, yet-to-be designed canisters are part of the foundation of the Yucca plan. They're the key defense against a transportation disaster, and they're one of the Department of Energy's primary barriers against radioactive leakage from the nuclear waste dump. But that's not important to the Department now, because the Nuclear Regulatory Commission has made the unexplainable decision that the Department of Energy's license application for Yucca was complete.

In order to get all of the nation's nuclear waste to Yucca, the Energy Department is proposing between 3,000 and 11,000 rail shipments, and as many as 10,000 truck shipments through Nevada. Twice a week for the next 24 years, trains loaded with the most dangerous substance known to man would traverse the country to Nevada.

Some of these shipments would go right by the Las Vegas Strip. Radioactive trains would pass within one-half mile of 95,000 residents and 34 hotels that employ and host 40,000 workers and visitors. Texas could host up to 300 nuclear waste shipments. All of these shipments will go through Arizona communities too, collecting even more waste at the Palo Verde nuclear plant.

The Department of Energy and nuclear industry lobbyists will tell you that the risk of an accident is low.

What they don't tell you is that risk is relative—99 percent success gets us 5,000 botched surgeries each week. 99 percent gets us 200,000 wrong drug prescriptions each year. 99 percent gets us 20,000 lost pieces of mail each hour. My point is simple—more nuclear waste on the road will involve more accidents that will put the lives of millions of Americans at risk. I don't want to see what 99 percent gets us when nuclear waste is involved.

What I fear most is that the Department of Energy is not going for 100 percent success. They are not even trying to eliminate all the risk. One of the most glaring examples is their refusal to consider shipping the oldest, less radioactive nuclear waste first—a very basic measure that could reduce radiological hazards by 85 percent or more.

I urge the Members of the Committee to ask the Department of Energy, the Nuclear Regulatory Commission, and the Academy of Sciences about this issue. Both the Academy and the Government Accountability Office have told the Energy Department they should ship older nuclear waste first. The state of Nevada—which understands the terrible risks—has urged the Department to consider shipping the oldest waste first.

But the Department of Energy made up its mind. The answer was no.

No, because the nuclear power industry wants to get rid of its more expensive and most radioactive waste first.

My question is why hasn't the Department of Energy even considered shipping the oldest waste first? They don't mention it in their environmental analyses for transporting waste to Yucca and they don't consider it in their draft National Transportation Plan.

It's unfortunate that the Energy Department once again is refusing to let logic get in the way of building its nuclear waste dump at Yucca Mountain.

We all know that nuclear waste cannot be stored at nuclear reactors for eternity. But it can be safely stored for a very long time in secure dry storage casks. If allowing nuclear waste to cool for 50 to 100 years improves the safety of shipping it in the future, the Department of Energy should be seriously considering on-site dry cask storage.

Storing waste at nuclear reactors, not in the earthquake-prone Yucca Mountain, would give us the time needed to develop secure, scientifically sound long-term solutions for nuclear waste. Senator Ensign and I have been saying this all along.

Yucca's price tag is now $96 billion, almost $49 billion MORE than the Department of Energy's 2001 estimate. As the cost of Yucca increases at a rate of $7 billion a year, the annual payments to the Nuclear Waste Fund are only a fraction of how much Yucca's cost is increasing. The $22 billion Nuclear Waste Fund will never come close to covering the price of Yucca.

The terrible risks of transporting nuclear waste is yet another reason that we need to stop the government from hemorrhaging any more money on this failed project. It's time to keep Americans safe by keeping nuclear waste where it is.

Again, thank you Mr. Chairman, Senator Hutchison and Members of the Committee for this opportunity.

The CHAIRMAN. And I thank you very much for your testimony, sir.

Now may I call the first panel, which consists of the following: the Director of the Office of Civilian Radioactive Waste Management, U.S. Department of Energy, the Honorable Edward Sproat; the Director of the Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Mr. Michael Weber; the Director of the Office of Safety Assurance and Compliance, Federal Railroad Administration, U.S. Department of Transportation, Mr. Ed Pritchard; and the Associate Administrator for Hazardous Material Safety of the U.S. Department of Transportation, Mr. Ted Willke.

Gentlemen, welcome, and may I begin with Director Sproat?

STATEMENT OF HON. EDWARD F. SPROAT III, DIRECTOR, OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT, U.S. DEPARTMENT OF ENERGY

Mr. SPROAT. Well, good afternoon, Mr. Chairman, and thank you very much for the invitation to appear and represent the Department in front of the Committee to talk about the transportation of spent nuclear fuel.

I ask that my formal testimony be entered into the record.

The CHAIRMAN. Your statement will be made part of the record.

Mr. SPROAT. Thank you very much.

I am going to keep my verbal comments very brief because we have a number of folks to speak this afternoon.

First of all, I would like to say that, obviously, there is a lot of misinformation about this whole issue of transportation of spent nuclear fuel and high-level waste. And I hope that in my comments I try and help the Committee understand some of those misconceptions and try and straighten out some of the information.

First of all, the concept of—as you pointed out in your opening statement, the transportation of spent nuclear fuel and high-level waste in this country is not something new. We have been shipping that hazardous material across the country by both rail and truck for over 40 years. And to be specific, just in the U.S. alone in the last 40 years, there have been over 3,000 shipments of spent nuclear fuel and over 6,000 shipments of transuranic waste by truck to the Waste Isolation Pilot Project in New Mexico since it opened. So there is a huge experience base in this country on how to transport radioactive materials safely and effectively. And in all those shipments, there has never once been any release of any radioactivity in the public environment.

There have been accidents, but none of those accidents have ever resulted in any releases because of the very robust containers and

the very robust regulations that the Department of Transportation and the Nuclear Regulatory Commission places on that transportation. And I will let the representatives of those organizations talk a little bit more about that in their presentations.

For Yucca Mountain, which obviously is one of the issues at the heart of this discussion in this hearing, I just want to make a comparison that compared to the 3,000 spent nuclear fuel shipments made so far in this country, at its peak of operation at Yucca, we are expecting that approximately 320 rail cars, which is two to three trains per week of shipments, will go from other places in the country to Yucca, and over 25 years, it would be 320 rail cars, or about two to three trains per week is what the total number of shipments would be to Yucca via rail and approximately 90 truck shipments per year. That compares to the existing transportation today in the U.S. of all hazardous materials of approximately 1 million rail cars of shipments in this country of hazardous materials, as classified by the Department of Transportation. So when you take a look at the total environment of hazardous waste transport in this country, radioactive materials is a very, very small percentage, and Yucca Mountain would be an even smaller percentage of that. So that is just to give you some kind of a context relative to the other hazardous material transportation this country already does and already accepts on a daily basis.

Dr. Crowley will talk later this afternoon about the National Academy of Sciences study which really addressed this whole issue, I think, very, very well. And it concluded that the risks to the public from shipping spent nuclear fuel are orders of magnitude less than the risks associated with a number of other hazardous materials like chlorine and like some of the other gases and chemicals that are shipped across the country, whose risks we routinely accept. And so I think the National Academy study, when you hear from Dr. Crowley, will put this in a little more perspective in terms of comparative risks of nuclear material shipment versus other hazardous waste shipment.

We at the Department of Energy have been working since 1992 with states, county, tribal, and local governments in what we call our Transportation External Coordination Working Group to start to work together with these various entities about the transportation issues associated with Yucca Mountain, both by rail and by truck. We have a very good working relationship with them, and we are committed to continuing that working relationship with them. We know that any successful transportation campaign in the future will require a very strong working relationship with those local communities.

So in summary, as we have the opportunity to talk about this a little bit more this afternoon, I would like to leave the Committee with the sense that, number one, this has been going on for a long time, the transportation of spent nuclear fuel and high-level radioactive waste.

The risks, as assessed by the National Academy of Sciences, are significantly lower than the risks associated with the existing transportation of hazardous materials in the U.S.

There are significantly more shipments of hazardous materials in the U.S. than nuclear materials, and we believe we have a very

strong and successful regime of regulation, both from the NRC and the Department of Transportation, which DOE is committed to adhering to as we go forward with the Yucca Mountain transportation campaign.

Thank you.

[The prepared statement of Mr. Sproat follows:]

PREPARED STATEMENT OF HON. EDWARD F. SPROAT III, DIRECTOR, OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT, U.S. DEPARTMENT OF ENERGY

Mr. Chairman and Members of the Committee, I am Edward F. Sproat III, Director of the Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM). I appreciate the invitation to appear before the Committee to discuss the safety and security of transporting spent nuclear fuel.

Since the early 1960s, more than 3,000 shipments of spent nuclear fuel have been conducted safely and securely in the United States, having traveled more than 1.7 million miles. There has never been a spent nuclear fuel transportation accident that has resulted in any release of radioactive material harmful to the public or the environment. The use of robust casks certified by the Nuclear Regulatory Commission (NRC), and strict regulatory standards for every aspect of logistics, including material characterization, packaging, loading, marking, equipment inspections, routing, training, security, and shipment monitoring, have all contributed to this outstanding safety record.

In 2006, the National Academy of Sciences published a study on the safety of spent nuclear fuel shipments titled: *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States.* In that report, the Academy concluded that from a technical viewpoint, these shipments present ". . . a low-radiological-risk activity with manageable safety, health and environmental consequences when conducted in strict adherence with existing regulations." The plans to ship spent nuclear fuel to the Yucca Mountain repository in the 2020 time-frame are building on this successful experience base.

Roles and Relationships

The Department of Transportation (DOT) and the NRC have established safety and security regulations for transport of spent nuclear fuel. DOE has committed to meet or exceed these regulations for shipments to Yucca Mountain. The Nuclear Waste Policy Act of 1982, as amended (NWPA) explicitly requires the Department to ship spent nuclear fuel and high-level radioactive waste to a repository in transportation casks certified by the NRC. Under the NWPA, the Department must also comply with NRC notification requirements prior to conducting such shipments. In addition, the NWPA requires the Department to provide states and tribes technical assistance and funds for training local public safety officials in safe routine transportation and emergency response procedures. The Department has selected mostly rail as the preferred mode of transport both nationally and in the state of Nevada for shipments to Yucca Mountain. The Department also has made the policy decision to use dedicated trains as the usual mode of rail service to enhance operational efficiency.

As the planning process for the Yucca Mountain transportation system evolves, we are continually looking for opportunities to further enhance the safety and security of these shipments. Post 9/11, the NRC has also imposed additional security measures for its licensees transporting spent nuclear fuel and other materials, many of which were measures DOE had put in place for its shipments years before. We are and will continue to coordinate our planning closely with NRC, DOT, and the Department of Homeland Security.

Once routes and shipment schedules are established, advance notification will be provided to individuals that have appropriate security clearance in each Governor's office in compliance with NRC regulations. All shipments will be accompanied by armed escorts and will be continuously monitored and tracked via satellite. We anticipate that most rail shipments will be conducted on dedicated trains, meaning no other materials will be transported on the same train, allowing for greater operational control of such shipments. Highway and rail shipments will be thoroughly inspected in accordance with standards of the Commercial Vehicle Safety Alliance or the Federal Railroad Administration, as appropriate, prior to departing from their points of origin.

Challenges and Issues

In their report on the safety of spent nuclear fuel shipments referenced above, the National Academy of Sciences addressed the relative risks of these shipments compared to other hazardous materials commonly transported in this country. Their findings demonstrate that each spent nuclear fuel shipment is thousands of times less risky than shipments of other commonly transported hazardous materials. This level of safety is the direct result of the stringent regulatory standards and robust packages used for such shipments.[1]

In addition to the lower risks for each shipment of spent nuclear fuel, there are far fewer of these shipments per year than shipments of other hazardous materials. In 2006, American railroads transported hazardous materials 111 billion ton-miles in over 1,000,000 rail cars. Of this total, less than 0.025 percent were spent nuclear fuel shipments.

The National Academy of Sciences, the transportation industry, the state of Nevada, and a broad spectrum of other stakeholders advocated strongly for a transportation system based on mostly rail shipments. Over the life of the repository, fewer than 3,000 trains can transport the same amount of spent nuclear fuel that would require more than 48,000 truck shipments. In addition, the use of Transportation, Aging, and Disposal canisters, which weigh up to 180 tons in their transportation configuration, requires the use of rail transport.

A significant fleet of transportation casks has to be developed to support shipments to Yucca Mountain. That process has started with funding for the design and certification of the Transportation, Aging and Disposal canisters and their transportation overpacks. Funding to support development of a fleet of approximately 150 transport casks that meet the stringent safety requirements of the NRC is needed as part of the transportation system. In addition, the Department needs to develop a fleet of rail cars with the best available safety technology. These rail cars will meet the new requirements established by the Association of American Railroads. The Department is collaborating with the Naval Nuclear Propulsion Program on development of the next generation of security escort rail cars designed to this new standard.

Current Status and Steps Moving Forward

In a 2004 Record of Decision, the Department selected mostly rail as its mode of transport, both nationally and in the state of Nevada. In June 2008, the Department completed the "Final Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada" (Rail Alignment EIS). The Rail Alignment EIS analyzes the environmental impacts associated with a range of potential alignments for constructing and operating a railroad in Nevada to Yucca Mountain. There was considerable public involvement in the development of the EIS and a Record of Decision is anticipated this fall.

As we move forward the Department will continue its ongoing collaborations with States, Tribes and stakeholders as we fulfill our commitment to establish a safe and secure transportation system for shipments to Yucca Mountain. I appreciate the Committee's interest on this important aspect of the Department's Yucca Mountain Program.

The CHAIRMAN. I thank you very much, sir.

Our next witness is Director Weber.

STATEMENT OF MICHAEL WEBER, DIRECTOR NUCLEAR MATERIAL SAFETY AND SAFEGUARDS U.S. NUCLEAR REGULATORY COMMISSION

Mr. WEBER. Good afternoon, Mr. Chairman and Senator Ensign. It is my pleasure to appear before you today to represent the staff of the U.S. Nuclear Regulatory Commission concerning the Nuclear Regulatory Commission's role in ensuring the safety and the security of potential transportation of spent fuel, including the potential transport of that spent fuel to the proposed repository at Yucca Mountain.

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[1] National Research Council of the National Academies, *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States* (Washington, D.C.: The National Academies Press, 2006), pp. 174–182.

As you know, the NRC staff has accepted for technical licensing review the application from the Department of Energy to construct a geologic repository for high-level waste at Yucca Mountain.

Spent nuclear fuel can be safely and securely transported. This conclusion is based on over 35 years of experience with spent fuel transportation both here in the United States and around the world. It is also based on the application of a comprehensive regulatory framework and effective oversight by the NRC working in partnership with other agencies such as the Department of Transportation.

Within the United States, there have been over 1,500 commercial shipments of spent fuel since 1979. All of these shipments have occurred without a single package failure or a radiological release, thus protecting workers and members of the public that live and work along the shipment routes.

The safety and security of spent nuclear fuel shipments are guided by a comprehensive regulatory framework. NRC's primary role is in the review and certification of transportation package designs. NRC would maintain this role for spent fuel transport to the proposed repository. Spent fuel is required to be shipped in extremely robust transportation packages that are designed and fabricated to withstand both normal transportation and hypothetical accident conditions.

Now, rather than become complacent with the existing safety record, the NRC continually examines the transportation program to ensure that our standards provide a high level of safety and security. The Commission published transportation risk studies in 1977, 1987, and again in 2000. These studies indicate that the risk of shipping spent nuclear fuel is very low. We are currently reexamining the spent nuclear fuel transportation risks that are likely to be encountered in potential shipments to the proposed repository.

In 2002, the NRC cosponsored an independent safety assessment of spent fuel transport by the National Academy of Sciences entitled *Going the Distance.* The NRC takes this study's recommendations very seriously and has addressed them in the program.

NAS recommended that full-scale testing of transport packages be used as part of an integrated approach along with technical analysis, computer simulation, scale-model, and package component testing. The study's recommendations are consistent with NRC's plans to perform a full-scale demonstration test involving realistic rail transport and fire scenarios.

NAS recommended that the NRC undertake additional analyses of transportation accidents involving long-duration, fully engulfing fires. The NRC has completed two such studies on the performance of representative spent fuel packages in severe rail and highway tunnel fires since the NAS made its recommendations and these studies confirmed that the spent nuclear fuel packages would not be expected to release any radioactive materials during the fire even under severe accident conditions.

More studies are underway and will be completed next year in 2009.

Finally, the NAS recommended an independent examination of the security of spent fuel and high-level waste transportation. In

light of the elevated threat that followed the terrorist attacks on September 11, 2001, the NRC conducted security assessments of transportation which were completed after the publication of the NAS report. These assessments evaluated transportation package designs against a variety of credible land-based and air threats. The results of the security assessments demonstrate that the current requirements, combined with security enhancements put in place after September 11, provide adequate safety and security.

In late 2009, the NRC intends to issue a proposed rule for public comment that would revise the requirements for secure transport of spent nuclear fuel, including additional security measures found necessary.

In addition, we believe that security measures for future shipments must defend against the threat that exists at the time of that shipment and take advantage of enhancements in technology which are constantly evolving. If the Yucca Mountain repository is approved, any shipments of spent fuel to this site would not begin until 2020 at the earliest based on current DOE estimates. Therefore, it may be more appropriate to conduct such an independent examination closer to the time of the actual shipments.

Although the NRC is responsible for overseeing the security of commercial spent fuel shipments to an interim storage facility, the Department would be responsible for implementing and overseeing the security of Yucca Mountain shipments because the Department plans to take title to the commercial spent fuel at the nuclear reactor sites. Therefore, any comprehensive security assessment would require participation of both the Department and the NRC, as well as the resources necessary to support such a study.

In conclusion, spent fuel can be safely and securely transported, including potential transportation under the existing regulatory framework. This conclusion is supported by the outstanding safety and security record for spent fuel shipments and numerous safety and security assessments conducted by the NRC and others such as the National Academy. Nevertheless, NRC staff remains committed in continually examining our transportation program to ensure safety and security are achieved and that the program remains effective in protecting people and the environment.

I want to thank you for the opportunity to testify before you today, and I look forward to answering any questions that you may have.

[The prepared statement of Mr. Weber follows:]

PREPARED STATEMENT OF MICHAEL WEBER, DIRECTOR, NUCLEAR MATERIAL SAFETY AND SAFEGUARDS, U.S. NUCLEAR REGULATORY COMMISSION

Introduction

Mr. Chairman and Members of the Committee, I am honored to appear before you today to testify on behalf of the U.S. Nuclear Regulatory Commission (NRC) staff concerning the NRC's role in ensuring the safety and security of the potential transportation of spent nuclear fuel, including the potential transport to the proposed geological repository at Yucca Mountain, Nevada. As you know, the NRC staff has accepted for technical review the application from the Department of Energy (DOE) to construct a geologic repository for high-level waste at this site.

Spent nuclear fuel can be safely and securely transported, including from its current location at operating and decommissioned nuclear power plants to a permanent geologic repository. This conclusion is based on over 35 years of experience with spent nuclear fuel transportation both here in the U.S. and around the world. It is

also based on the application of a comprehensive regulatory framework and effective oversight by the NRC, the U.S. Department of Transportation (DOT), the Department of Energy (DOE), States, and Tribal governments. Within the U.S., there have been over 1,500 commercial shipments of spent fuel from nuclear power reactors since 1979. All of these shipments have occurred without a single package failure or radiological release. This means that there have been no radiological releases or injuries to workers or the public who live and work along these shipment routes. It is our understanding that the transportation safety record also extends to the approximately 30,000 international spent fuel shipments made primarily by Japanese and European companies engaged in the reprocessing of spent fuel.

Regulatory Framework

The safety and security of spent nuclear fuel shipments are guided by a comprehensive regulatory framework that includes the NRC, DOE, DOT, the States, and Tribal governments. This regulatory framework is informed and closely aligned with the International Atomic Energy Agency (IAEA) Transportation Safety Standard to ensure international alignment of transportation package performance standards and requirements. The NRC's primary role in ensuring the safety and security of spent nuclear fuel and high-level waste shipments is the review and certification of the package designs that are to be used for shipment. NRC would maintain this role for the proposed high-level waste repository. Spent fuel is required to be shipped in extremely robust transportation packages that are designed and fabricated to withstand normal transportation and hypothetical accident conditions. The certification process requires a comprehensive technical review by the NRC staff of the package's expected performance under hypothetical accident conditions. The specific conditions have been derived from and are intended to envelope the impact forces and thermal environments experienced in severe, "real world" accidents. To be certified by the NRC, a vendor must demonstrate that a transportation package design will prevent the release of radioactive material and the loss of radiation shielding when subjected to the hypothetical accident conditions.

For commercial shipments of spent nuclear fuel by NRC licensees, the NRC also approves the Quality Assurance (QA) programs that apply to the design, fabrication, use and maintenance of transportation packages and requires that shipments comply with NRC regulations for the physical security of spent fuel in transit (10 CFR Part 73). NRC's QA and security regulations do not apply to DOE's shipments to the proposed high-level waste repository.

In general, DOT regulates the transport of all hazardous materials, including spent nuclear fuel, and has established regulations for shippers and carriers regarding radiological controls, hazard communication, training, emergency response, and criteria to determine preferred routes for hazardous material shipment. The states and tribal governments bear primary responsibility for responding to accidents and incidents within their jurisdictions and in many cases the states have enacted additional requirements for carrier inspections and escorts. For potential shipments to the proposed high-level waste repository at Yucca Mountain, the DOE would be responsible for ensuring the security of the shipments, because DOE plans to take title to commercial spent fuel at nuclear reactor sites. Congress has also directed DOE to abide by NRC requirements for providing advance notifications of shipments to State and local governments.

NRC's Efforts to Maintain Safety and Security of Spent Nuclear Fuel Transportation

Rather than be complacent with existing safety performance of transportation packages, the NRC continually examines the transportation program to ensure that our standards provide a high level of safety and security. The Commission published transportation risk studies in 1977, 1987, and 2000. These studies indicate that the risk of shipping spent nuclear fuel is very low. To supplement previous efforts, we are currently re-examining spent nuclear fuel transportation risks to account for the spent nuclear fuel, shipping cask and shipment characteristics likely to be encountered in potential shipments to the proposed geologic repository.

In 2002, the NRC co-sponsored an independent safety assessment by the National Academy of Science's (NAS's) Board on Radioactive Waste Management of spent nuclear fuel (SNF) and high-level waste (HLW) transportation, entitled Going the Distance which was published in February 2006. The NRC takes this study's recommendations very seriously and addressed them in our program.

The principal finding of the NAS study was:

> The Committee could identify no fundamental technical barriers to the safe transport of SNF and HLW in the United States. Transport by highway (for small-quantity shipments), and by rail (for large-quantity shipments) is, from

a technical viewpoint, a low-radiological-risk activity, with manageable safety, health, and environmental consequences, when conducted with strict adherence to existing regulations.

The NAS study recommended that full-scale testing continue to be used as part of an integrated approach, along with technical analysis, computer simulation, scale-model, and package component testing programs, to confirm that transportation packages perform acceptably under both regulatory and credible conditions that exceed regulatory requirements. The study also concluded that "deliberate full-scale testing of packages to destruction through the application of forces that substantially exceed credible accident conditions would be marginally informative and is not justified given the considerable cost for package acquisitions that such testing would require." The study's recommendations are consistent with NRC's current plans in the Package Performance Study (PPS) to perform a demonstration test involving a realistic rail impact and fire scenarios. We believe that the NAS study also supports NRC's decision not to test a full-scale transportation package to destruction in the PPS. Work on the PPS has been deferred by the NRC and DOE until the final transportation cask designs, including the transport, aging, and disposal (TAD) canisters, are deployed. We are currently working with international counterparts in Japan and Germany to learn from their full-scale and model testing to prepare for full-scale testing in the U.S.

NAS recommended that NRC undertake additional analyses of transportation accidents involving very long-duration, fully engulfing fires to determine whether there is a need for regulatory change or additional operational controls during spent nuclear fuel shipments. The NRC has completed two studies on the performance of representative spent nuclear fuel packages in severe rail and highway tunnel fires: "Spent Fuel Transportation Package Response to the Baltimore Tunnel Fire Scenario," NUREG/CR–6886 (published December 2006), and "Spent Fuel Transportation Package Response to the Caldecott Tunnel Fire Scenario," NUREG/CR–6894 (published February 2007). These studies confirmed that the spent nuclear fuel packages would not be expected to release any radioactive material from the spent fuel, even under these severe accident conditions.

Through this work, the NRC identified an additional operating control for rail shipments that could be implemented to prevent or mitigate the consequences of long-duration fires: to prohibit a train carrying flammable gases or liquids from being in a tunnel at the same time as a train carrying spent nuclear fuel. Because the NRC does not have regulatory authority over rail carriers, we requested in March 2006, that the Association of American Railroads (AAR) consider revising AAR Circular No. OT–55, *Recommended Railroad Operating Practices For Transportation of Hazardous Materials.* As a result, the AAR did issue a revision in July 2006 (AAR Circular No. OT–55, Revision I) which states ". . . when a train carrying SNF or HLW meets another train carrying loaded tank cars of flammable gas, flammable liquids or combustible liquids in a single bore double track tunnel, one train shall stop outside the tunnel until the other train is completely through the tunnel."

Finally, the NAS study also recommended that, ". . . an independent examination of the security of spent fuel and high-level waste transportation should be carried out prior to the commencement of large-quantity shipments to a Federal repository or to interim storage." In light of the elevated threat that the U.S. experienced following the terrorist attacks on September 11, 2001, the NRC issued safeguards advisories and orders to enhance transportation security of spent nuclear fuel and other large quantities of radioactive material. The NRC issued these security enhancements in coordination with DOT, the Department of Homeland Security, State agencies, and other Federal agencies. The NRC security assessments of transportation, which were completed after the publication of the NAS report, evaluated a number of representative transportation package designs against a variety of credible land-based threats and a deliberate plane crash. The results of these security assessments, which we have shared with DOT, DOE, and other organizations that have a "need to know," demonstrate that the current requirements, combined with the security enhancements put in place after September 11th, provide adequate protection of public health and safety, and the environment, and common defense and security. These safeguards advisories and orders are only an interim solution and will not be relied on indefinitely. In late 2009, the NRC intends to issue a proposed rule for public comment that would revise the requirements for secure transport of spent nuclear fuel. The proposed rule would include additional measures to address the current threat environment.

In addition, we believe that the security measures for future shipments must defend against the threat that exists at the time of shipment and take advantage of enhancements in technology, such as shipment tracking and monitoring techniques,

which are constantly evolving. If the Yucca Mountain repository is approved, any shipments of spent nuclear fuel to this site would not begin until 2020 at the earliest, based on current DOE estimates. Therefore, it may be more appropriate to conduct an independent examination of shipment security closer to the time of actual shipments, if needed.

While the NRC is responsible for overseeing the security requirements for commercial shipments to an interim storage facility, DOE would be responsible for implementing and overseeing the security requirements for Yucca Mountain shipments. Therefore, a comprehensive independent security assessment that encompasses both potential shipments to Yucca Mountain or to an interim storage site would require the participation of both NRC and DOE as well as resources to support such a study.

In an effort to further inform our program, the NRC is also examining two recent transportation accidents involving severe highway fires. One is the MacArthur Maze (Interstate I–880) accident in Oakland, California that occurred on April 29, 2007, in which a gasoline tanker truck with a capacity of 32,500 liters (8,600 gallons) of gasoline crashed and overturned on an interstate highway. The resulting fire was intense enough to cause the collapse of a highway overpass located above the overturned tanker truck. The second accident being studied occurred on October 12, 2007, within the southbound "truck only" bypass tunnel at the I–5/14 interchange in northern Los Angeles County (Newhall Pass). In this accident, multiple commercial trucks were involved in a severe fire occurring in a short, well-ventilated tunnel. We expect the results of these studies to be published in early 2009.

Summary

In conclusion, spent nuclear fuel can be safely and securely transported from its current location at operating and decommissioned nuclear power plants, including potentially to a permanent geologic repository, under the existing regulatory framework. This conclusion is supported by the outstanding safety record for spent nuclear fuel shipments to date and numerous safety and security assessments conducted by the NRC, the NAS, and other agencies. Nevertheless, the NRC staff is committed to continually examining our transportation safety and security program to ensure that it remains effective in protecting people and the environment.

Thank you for the opportunity to discuss NRC's transportation safety and security program for spent nuclear fuel. I look forward to answering any questions you may have.

The CHAIRMAN. I thank you very much, Director Weber.

And now may I call upon Director Pritchard?

STATEMENT OF EDWARD W. PRITCHARD, DIRECTOR, OFFICE OF SAFETY ASSURANCE AND COMPLIANCE, FEDERAL RAILROAD ADMINISTRATION, U.S. DEPARTMENT OF TRANSPORTATION

Mr. PRITCHARD. Good afternoon, Mr. Chairman and Senator Ensign and Members of the Committee. Thank you for the opportunity to appear today on behalf of the Secretary of Transportation, Mary Peters, and the Administrator of the Federal Railroad Administration, Joseph Boardman. I am Edward Pritchard, Director of FRA's Office of Safety Assurance and Compliance.

Part of FRA's role in protecting the American public from the risk inherent in rail transportation includes promoting the safe and secure transportation of spent nuclear fuel. With the Department of Energy's decision that 80 percent or more of the nuclear materials to be stored at Yucca Mountain should be transported there by rail, it is important to consider the safety and security of these new shipments during rail transportation. FRA's role is important in this regard and we are up to the challenge.

FRA has been hard at work to assure the safe transportation of radioactive materials since the formation of the U.S. Department of Transportation. We formalized our program for these shipments in the late 1980s and we are taking steps to ensure the continued

safety of such shipments as they move through the Nation's rail transportation system. We do this in two main ways, giving technical assistance to other agencies and carrying out our comprehensive safety enforcement and rulemaking program.

First, we provide technical expertise and assistance to other agencies. We actively work with our partner agencies, including the Department of Energy, the Nuclear Regulatory Commission, and the Pipeline and Hazardous Materials Safety Administration, and the Transportation Security Administration. Our cooperative efforts with DOE include all rail-related aspects before the plan moves to Yucca Mountain. This cooperation includes vigorously participating in their external stakeholder working groups and contributing technical and operational expertise regarding the rail operating environment, mechanical equipment requirements, and track construction and maintenance.

I am proud to say that the same degree of coordination exists throughout the various modal administrations within the DOT, as well as with the NRC and TSA, in regard to issues, concerns involving the security of rail movements and routing, package integrity and securement in the rail operating environment. These relationships are strong, and together our work is progressing to ensure that any shipment of spent nuclear fuel transported to the Yucca Mountain repository by rail is conducted in a way that assures not only the safety and security of these tasks with transporting the shipment, but also the safety and security of the American public as a whole.

Second, FRA provides technical and regulatory oversight to ensure that the rolling equipment and railroad infrastructure used for the movements are safe. FRA's efforts are focused on ensuring the rail cars that will move the casks of spent nuclear fuel are the safest possible and utilize the most advanced technology. We have developed and instituted a comprehensive safety enforcement program that ensures that the tracks and other rail infrastructures conform with the extensive body of Federal railroad safety regulations.

We are working with our sister agency, PHMSA, to implement PHMSA's new routing regulations that require rail carriers to analyze potential routes for transporting these shipments and to select the most safe and secure routes.

But these efforts are not the only ways in which FRA works to advance rail safety. FRA and the administration are strong supporters of positive train control technology, are active advocates for the continued development of positive train control, and we share the desire of the National Transportation Safety Board and Congress to see that the positive train control becomes a reality on more railroads.

I appreciate the opportunity to discuss FRA's program to assure the safe and secure transportation of spent nuclear fuel by rail. Thank you. I will be pleased to answer any questions you may have.

The CHAIRMAN. Thank you very much, Director Pritchard.

And may now I call upon Associate Administrator, Mr. Willke?

STATEMENT OF DR. THEODORE "TED" WILLKE, ASSOCIATE ADMINISTRATOR, HAZARDOUS MATERIALS SAFETY, PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION, U.S. DEPARTMENT OF TRANSPORTATION

Dr. WILLKE. Good afternoon, Mr. Chairman and Senator Ensign. I am Ted Willke, Associate Administrator for Hazardous Materials Safety, Pipeline and Hazardous Materials Safety Administration, PHMSA, the U.S. Department of Transportation. Thank you for the opportunity to appear today to briefly discuss PHMSA's role in the safe and secure transportation of spent nuclear fuel and high-level radioactive waste to the proposed geological repository at Yucca Mountain, Nevada.

For some 50 years, some 1,500 domestic shipments of spent nuclear fuel have been transported within the United States with a solid safety record. It is our firm belief that this fuel can be safely and securely transported from its current location at operating and decommissioned nuclear power reactors to a permanent repository. Our confidence is based on the application of a comprehensive regulatory framework that includes DOT, the Nuclear Regulatory Commission, the Department of Energy, the Department of Homeland Security, and State and tribal governments. We have a commitment to continually reexamine the transportation program to ensure that the current level of safety and security is maintained.

Under the Nuclear Waste Policy Act of 1982, the Department of Energy has primary responsibility to plan for and arrange the transportation for spent nuclear fuel to a geological repository. The act requires all transportation to be conducted in accordance with the transportation regulations issued by DOT in transport casks approved by the Nuclear Regulatory Commission.

Within the Department of Transportation, several agencies are involved in regulating the transportation of spent nuclear fuel. PHMSA maintains a national program designed to protect life, property, and the environment from risks inherent in the transportation of hazardous materials in commerce, including spent nuclear fuel and high-level radioactive waste. To carry out this role, PHMSA identifies and evaluates safety risks, develops and enforces standards for transporting hazardous materials, educates shippers and carriers, investigates transport and packaging incidents and failures, conducts research, and awards grants to improve emergency response to incidents.

PHMSA's regulations, issued under the Federal hazardous materials transportation safety laws, establish commodity-specific standards for the classification, packaging, marking, labeling, and documentation of hazardous material shipments by rail, highway, vessel, and air. PHMSA's hazardous regulations also prescribe standards for the loading and unloading of transport conveyances, training of transportation employees, and the security of hazardous materials in transportation.

While PHMSA is proud of its contributions to the safe transportation of spent nuclear fuel, the true strength of this program lies in the shared responsibility and cooperation between our Federal, State, and local partners. Within the Department of Transportation, responsibility for enforcement of the hazardous material regulations is shared with the Federal Railroad Administration and

the Federal Motor Carrier Safety Administration. We also share enforcement responsibilities with the United States Coast Guard and State law enforcement officials. For all radioactive shipments, particularly spent nuclear fuel, PHMSA works closely with the Nuclear Regulatory Commission to ensure consistent and uniform packaging and transport regulations.

Because our State partners have the primary responsibility for responding to accidents and incidents within their jurisdiction, PHMSA will continue to support effective training to prepare first responders for a possible transportation accident or incident involving spent nuclear fuel through their jurisdictions and that will include financial assistance to states and localities for emergency response, planning and training. PHMSA will continue to coordinate with local responders and ensure that they receive the advance shipment notifications and general hazard communications they need to respond to transport incidents.

As planning for the repository progresses, PHMSA will continue to work with the Congress, the nuclear industry, the transport community, and appropriate Federal, State, tribal governments, and local agencies to review and improve existing safety standards, promote the development of risk-reducing technologies, strengthen the preparation of emergency responders and otherwise enhance the system of safety controls for spent nuclear fuel transportation. With continued vigilance, PHMSA is committed to maintaining the strong record of safety and security.

I appreciate the opportunity to discuss PHMSA's transportation safety and security program. I would be pleased to answer any questions.

[The prepared statement of Mr. Pritchard and Dr. Willke follow:]

WRITTEN STATEMENT OF TED WILLKE, ASSOCIATE ADMINISTRATOR, HAZARDOUS MATERIALS SAFETY, PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION; AND EDWARD PRITCHARD, DIRECTOR, OFFICE OF SAFETY ASSURANCE AND COMPLIANCE, FEDERAL RAILROAD ADMINISTRATION, U.S. DEPARTMENT OF TRANSPORTATION

Introduction

Chairman Inouye, Ranking Member Hutchison, and Members of the Committee, we want to thank you for the opportunity to appear today on behalf of the Department of Transportation (DOT). We are pleased to discuss DOT's role in the safe and secure transportation of spent nuclear fuel (SNF) and high-level radioactive waste (HLRW) to the proposed geological repository at Yucca Mountain, Nevada.

The Safety Record

SNF and HLRW have been transported within the United States for more than 50 years, with a solid record of safety and security. More than 1,500 shipments of commercial SNF from nuclear power reactors have moved by road and rail without a single incident resulting in an injury, death, or release of the material from the packaging. Likewise, numerous military shipments of SNF; thousands of non-commercial spent fuel and HLRW shipments by the Department of Energy (DOE); and approximately 30,000 international shipments of SNF have occurred without serious incident.

Regulatory Roles

Under the Nuclear Waste Policy Act of 1982, DOE has primary responsibility to plan for and arrange the transportation of SNF to a geological repository. The Nuclear Regulatory Commission (NRC) is responsible for licensing the geological repository and whatever interim facilities may be needed. Transportation will be conducted, in accordance with hazardous materials transport regulations issued by DOT, in transport casks approved by the NRC. States will bear primary responsibility for responding to accidents and incidents within their jurisdictions and in

many cases have enacted additional requirements for carrier inspections and escorts. DOE, DOT, and the Federal Emergency Management Agency have provided grants, courses, and course materials for emergency responder training and preparedness related to this transportation. Because DOE plans to take title to the SNF at nuclear reactor sites, that department will be responsible for ensuring the security of the shipments.

DOT Role in Promoting Transportation Safety

Within DOT, several agencies are involved in overseeing the transportation of SNF. The Pipeline and Hazardous Materials Safety Administration (PHMSA) administers a national program designed to protect life, property, and the environment from risks inherent in the transportation of hazardous materials, including SNF, in intrastate and interstate commerce. To these ends, PHMSA identifies and evaluates safety risks; develops and enforces standards for transporting hazardous materials; educates shippers and carriers; investigates transport and packaging incidents and failures; conducts research; and awards grants to improve emergency response to incidents. PHMSA regulations, issued under the Federal hazardous materials transportation safety laws (49 U.S.C. ch. 51), establish commodity-specific standards for the classification, packaging, marking, labeling, and documentation of hazardous materials shipments by rail, highway, vessel, and air. PHMSA's Hazardous Materials Regulations (HMR) also prescribe standards for the loading and unloading of transport conveyances; training of transportation employees; and security of hazardous materials in transportation.

PHMSA shares responsibility for enforcement of the HMR with the Federal Railroad Administration (FRA), the Federal Motor Carrier Safety Administration (FMCSA), the United States Coast Guard, the Federal Aviation Administration, and state law enforcement officials.

For shipments of SNF, PHMSA also works closely with the NRC. PHMSA's regulations incorporate rigorous packaging standards that are developed and overseen by the NRC. Pursuant to a 1979 Memorandum of Understanding, with PHMSA, the NRC has lead regulatory responsibility for the review and certification of the shipping casks used to transport SNF. These casks are performance-tested to assure they can survive "hypothetical" accident scenarios. The tests, which include impact, puncture, thermal and immersion testing, also assure that the casks provide excellent radiation protection to transportation workers who load, unload, or carry SNF and to any member of the general public who may come into proximity with a shipment of nuclear material during its movement in transportation. Because the time that it takes to move a shipment from origin to destination directly affects radiation exposure, the NRC requires that shipments of SNF be planned to avoid intermediate stops to the extent practicable. PHMSA's regulations also prohibit unnecessary delay in the transportation of hazardous materials.

FRA enforces the HMR applicable to rail shipments as part of a national safety program covering all aspects of railroad operations. FRA regulations issued under the Federal railroad safety laws (49 U.S.C. ch. 201–213) govern the design, maintenance, and inspection of track, equipment, signals, and train control systems and prescribe standards for employee qualifications, training, and operating practices. FRA also advises PHMSA on rulemakings involving the rail transportation of hazardous material and enforces the HMR in the rail mode. Railroads are required to conduct their own inspections to ensure that these safety standards are being met. Approximately 500 Federal and State safety inspectors monitor the railroad companies' own inspection forces to verify compliance with applicable Federal safety standards. FRA and State inspectors accomplish this task by conducting routine inspections and programmed focused inspections of railroad properties and comparing their findings to a railroad's own inspection records, as well as conducting compliance investigations. Thus, while primary responsibility for inspecting the railroad property and operations rests with the railroads themselves, FRA's inspection strategy is to ensure the integrity and effectiveness of the railroads' own inspection programs in complying with applicable Federal safety regulations and standards. In the case of SNF shipments, as set forth in the following section, FRA and rail carriers have taken a number of actions to further strengthen safety and security controls.

Although rail will be the primary mode of transportation for SNF shipments to the repository, some motor carrier movements also will be necessary. In addition to the HMR, these movements will in accordance with FMCSA regulations governing vehicle condition, driver safety, and security. Under FMCSA's regulations, a motor carrier transporting SNF must hold a safety permit issued by FMCSA, and a pretrip inspection of the shipment must be performed by an authorized State or Federal law enforcement official. In addition, states may designate preferred routes for highway shipments of SNF, in accordance with FMCSA's regulations. Preferred

routes are interstate highways and alternate routes designated by a State routing agency. An interstate bypass or beltway around a city, when available, must be used rather than an interstate route through a city. Under these regulations, a State or locality may not designate (or restrict the use of) routes that "export" transportation risks to a neighboring jurisdiction or unnecessarily delay the transportation of hazardous materials.

Emergency Response

Effective response to a transportation accident or incident involving SNF is enhanced through Federal requirements and resources, including financial assistance to states and localities for emergency response planning and training. DOE maintains regional emergency management field offices that can dispatch qualified response teams to an incident involving nuclear material, but first responders are primarily local fire departments and law enforcement agencies. (In the event of a radiation emergency, emergency response is typically handled by the appropriate state radiation control agency and first responders are trained to stay clear and call the state radiation control officer.) PHMSA's hazard communication requirements (shipping papers, package marking and labeling, and vehicle placarding) inform these responders of the hazards involved. For shipments of SNF, coordination with local responders is also enhanced by the NRC's physical protection requirements that provide for advance notification to the State Governor (or his representative) of each shipment to or through the state and advance arrangements with local law enforcement agencies for response to an emergency or a call by escorts for assistance. Local emergency response capabilities are strengthened by PHMSA's planning and training grants to States, who in turn pass at least 75 percent of the grants through to local communities.

Rail Transportation of Radioactive Materials

With regard to rail transportation of SNF and HLRW in particular, FRA conducts inspections to verify that shipments are properly prepared for rail transportation and in compliance with all applicable provisions of the HMR. FRA also helps to ensure that the track, signal systems, grade crossings, bridges, and rail vehicles used for these shipments are in safe condition and that responsible railroad employees involved in these movements are trained, briefed, and properly performing their jobs. In these activities, FRA works very closely with the railroads, their employees, and the affected communities. Ultimately, the safe movement of SNF and HLRW depends on the application of sound safety regulations, policies, and procedures. This requires extensive planning and coordination among Federal agencies, State and local governments, and commercial transportation companies.

Since the mid-1980s, FRA has implemented a basic focused inspection policy for all known rail shipments of SNF and HLRW. In 1998, with the advent of a significant potential for increased SNF and HLRW by rail, FRA recognized the need to enhance the existing policy to ensure that the railroad industry's outstanding safety record for nuclear material shipments could continue unabated. This updated policy, the *Safety Compliance Oversight Plan for Rail Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel,* known as SCOP, set forth an enhanced FRA policy to address the safety of rail shipments of SNF and HLRW. FRA applies this enhanced policy to ensure the safety of all known rail shipments of SNF and HLRW. The SCOP is a "living document" periodically requiring modification and update as needed based on new regulations, technologies, and procedures.

The development of the SCOP involved a coordinated effort among FRA, DOE, the Association of American Railroads (AAR), railroad labor organizations, and representatives of affected states and Native American groups, and FRA acknowledges the invaluable contribution of each of them. Key elements of the SCOP include the following: (1) coordinated planning for selecting the most appropriate and viable routes, (2) ensuring appropriate training of railroad employees and emergency responders, and (3) enhancing and focusing FRA's safety inspections and monitoring activities on all facets of the rail shipments of SNF and HLRW.

Under current route-selection requirements, FRA works with DOE, utility companies, or other shippers, and the involved railroad companies in planning and selecting the routes, emphasizing the selection of the highest classes of track. (Under FRA's regulations, each higher class of track has a greater permissible operating speed and more stringent safety standards.) Additional requirements for selecting the safest and most secure routes for transporting SNF and other high-hazards materials were also adopted in PHMSA's interim final rule, "Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments," published on April 16, 2008. Under these requirements, a rail carrier must analyze the routes over which these materials may be transported and, based on that analysis, select

the safest and most secure route to be used. The Transportation Security Administration (TSA) is also engaged in a rulemaking that includes proposals to enhance the security of rail shipments of certain hazardous materials, including SNF, by requiring carriers to designate a security coordinator, report security concerns to TSA, establish a chain of custody for shipments, and advise TSA of the location and other specific information regarding shipments within 1 hour of a request from TSA.

FRA also coordinates with Operation Lifesaver, Inc., a private safety organization, to increase grade crossing safety awareness and education in communities along routes. FRA works with appropriate agencies of the Department of Homeland Security, the NRC, and DOT's Office of Intelligence and Security in identifying security issues and measures. FRA assists with coordination among the shipper, Federal and local law enforcement representatives, and intelligence communities on security matters. Finally, FRA reviews the security and emergency response plans of the shipper and the rail carrier to ensure that they adequately address the transportation security risks and the actions to be taken along the route in the unlikely event of an accident or incident.

Another important element of the SCOP is training. It is FRA's policy to assist DOE and other shippers in the development of emergency response training and safety briefings and to monitor the rail carrier and the shipper to verify that requisite training and briefings have been performed. FRA also conducts reviews to ensure that train crews who operate the trains in which nuclear materials are transported are properly certified, trained, and experienced in running over the routes. Finally, FRA checks to see that these crews have received specific training concerning the nature of the shipments.

Federal regulations for shipment of nuclear material by rail are augmented by a series of safety and security protocols and special operating restrictions that have been agreed upon by DOE and the railroads. These protocols and operating restrictions, AAR Circular OT–55–I, Recommended Railroad Operating Practices for Transportation of Hazardous Materials and AAR Standard S–2043, Performance Specification for Trains Used to Carry High-Level Radioactive Material, for example, have evolved over the years and are often tailored to the particular needs of these types of shipments. Under these protocols, a train carrying SNF or HLRW would typically include the cask cars, at least two buffer cars, and an escort car. One buffer car is before and one is after the cask cars; the buffer cars are required by regulation and not only provide separation from the occupied locomotive and from the escort car but also act as a cushion against direct impacts on the cask cars in the event of a collision. The escort car would be staffed with appropriate nuclear safety and security personnel. Special operating restrictions have included limitations on the maximum speed of trains carrying nuclear materials, requirements to stop opposing trains on adjacent tracks when they meet a train carrying nuclear materials, and requirements that cars carrying nuclear material be switched only with an attached locomotive rather than allowing them to roll to a stop on their own during switching.

Another convention involving the shipment of SNF and HLRW by rail concerns the use of dedicated trains. Until the mid-1970s, most rail shipments of these radioactive materials were handled in regular service trains that carried a wide variety of other freight in addition to radioactive materials. However, in 1974, the railroad industry adopted a strong position that radioactive materials shipments should move in dedicated trains that transport only the radioactive material. Under a congressional mandate, FRA engaged the services of the John A. Volpe National Transportation Systems Center to conduct a thorough study of the safety implications surrounding the transportation of SNF and HLRW in dedicated trains versus regular service trains. In September 2005, FRA transmitted its March 2005 report containing the study's results to the Congress, "Use of Dedicated Trains for Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel." The report concluded that dedicated train service offers the lowest accident probability and can reduce radiation exposure in the event of an accident by mitigating the consequences and simplifying wreck clearance. The report also stated that additional research is needed to fully assess the costs and risks of transporting SNF. The Department is conducting additional research to assess conditions for the transportation of SNF and expects to issue a responsive notice of proposed rulemaking in Fiscal Year 2009.

The security of rail shipments of radioactive materials has long been a priority even before the tragic events of September 11. Some of the protocols described above contain stringent security measures to protect against terrorist threats, including the accompaniment of these shipments by armed security forces, direct liaison with State and local law enforcement and first responders, and requirements to protect the cars when sitting in rail yards or sidings.

Conclusion

Through its comprehensive safety programs, and key partnerships with other Federal, State, and local authorities, DOT is prepared for the additional shipments of high-level radioactive materials associated with the opening of a proposed new geological repository for SNF. As planning for the repository progresses, DOT will continue to work with the Congress, the nuclear industry, the transport community, and appropriate Federal, State, and local agencies to review and improve existing safety standards; promote the development of new risk-reducing technologies; strengthen the preparation of emergency responders; and otherwise enhance the system of safety controls for SNF and HLRW transportation. With continued vigilance, DOT is committed to maintaining the strong record of safety and security established over the last 50 years.

We appreciate the opportunity to discuss DOT's transportation safety and security program for SNF. Thank you. We would be pleased to answer any questions you may have.

The CHAIRMAN. I thank you very much, Secretary Willke.

Circumstances require my absence here. I have another assignment, and the chair will be relinquished to Senator Ensign. But before I go, I would like to thank all of you for participating in this hearing.

I would like to just note something. I know that all of you have testified that the transport of hazardous material, especially spent fuel, is safe under the present technology. But yet, you have noted that there have been accidents but no leakage. And one of the witnesses compared spent fuel with chlorine. But I recall that chlorine is poisonous, but I do not think it lasts for a thousand years. On the other hand, spent radioactive fuel as a dangerous element in that would live for thousands of years. And if you can get into an accident, some day it may leak. So I just want to make that notation.

Mr. Chairman?

Senator ENSIGN [presiding]. Thank you, Mr. Chairman. I just have a few questions for the panel.

Mr. Sproat, if you could answer the question on transportation timing. When is the earliest that DOE could—not when you expect when they will but when is the earliest that you actually could start shipping waste to Yucca Mountain?

Mr. SPROAT. Senator, in order for us to be able to accept the nuclear waste and begin shipment, we would need a license from the Nuclear Regulatory Commission to receive and possess that nuclear fuel whether it is at Yucca Mountain or some other interim storage site. The earliest, if everything went right and the funding was not an issue, which we both know is an issue with Yucca, that could be would be 2020. How long the licensing proceeding is going to last, what the outcome of the licensing proceeding is going to be remains to be seen, but the earliest would be 2020. So really it is 12 years in the future.

Senator ENSIGN. You could not ship it earlier?

Mr. SPROAT. No, Senator, we cannot because we need that license to receive and possess, to be able to take it. And not only the license from the Nuclear Regulatory Commission, but by the Nuclear Waste Policy Act, the repository needs to have a license to operate in order for us to accept the fuel and take title to it by the Nuclear Waste Policy Act.

Senator ENSIGN. I thought that DOE was going to accept title to the waste beforehand while it was still at the sites.

Mr. SPROAT. As of right now, we are not able to do that.

Senator ENSIGN. Does there have to be a change in the law for you to do that?

Mr. SPROAT. Yes, sir.

Senator ENSIGN. It was mentioned 9/11, and Mr. Weber, I think you were the one who kind of mentioned 9/11. That day when we were watching those buildings go down and a lot of engineers around the country were watching those buildings go down and certainly people who had designed those buildings never—you know, they thought about earthquakes. They thought about a lot of things, but when people were watching those things, very few people I think understood that those buildings could actually collapse.

Have those types of extreme circumstances—you know, the fire was much more intense where it melted the metal. Have those kind of extreme circumstances been taken into account? For instance, you mentioned air attacks. Have those kind of really extreme circumstances, however unlikely, still possible, been taken into account studying the potential casks and being able to transport these containers?

Mr. WEBER. Yes, sir, they have. 9/11—that night I spent in our emergency operations center. So I watched the replay of the video over and over and over again.

But it is important to point out that security is not something that we discovered after 9/11. We have been putting these packages through their paces well before 9/11. When NRC was created, safeguards and security was a big deal with the American public, and that is why my office, in part, was created. So well before 9/11, we have been conducting destructive experiments. We have been doing computer simulations. We have been doing modeling.

Senator ENSIGN. Have you done actually—instead of just computer modeling, have you done actual to where you have gotten the temperatures up for potential—what we just talked about, a plane crash coming in, jet fuel burning, train crashes where you can have some different types of fuels burning at extreme temperatures for long periods of time? Have you actually done that not just with computer models, but with life-sized models of what the transportation containers would be?

Mr. WEBER. Not for the spent fuel containers, the packages that are currently being planned for use. We have done it for other type B packages and it has been tested overseas by other countries. Germany, for example, has done full-scale testing.

One of our standard tests that the packages have to withstand a test involving a pool of aviation fuel that is burned for a prolonged period of time, and the package has to withstand that kind of extreme test in order to meet our requirements.

Senator ENSIGN. If you could give me just a documentation on what those temperatures reach, the type of materials, and how long they were required to do that for the record, I would very much appreciate that.

Mr. WEBER. If I could, Senator, this requirement that is in our regulations is for 1475 degrees Fahrenheit for at least 30 minutes. That is our standard fire test that the package has to withstand.

Now, since then we have been proactive——

Senator ENSIGN. I was going go to say some of these fires are going to last a lot longer than 30 minutes.

Mr. WEBER. Oh, yes. And since then we have been proactive in reaching out around the country, as we see additional extreme accidents not involving radioactive material, but we use those incidents to understand the physics, the mechanics, what actually occurs because our objective is to reconfirm the safety of the transportation packages.

Senator ENSIGN. You mentioned Germany. Has Germany done those—you said they have done those studies. Have theirs just been for 30-minute fires? You said they have done full-scale. Can you get the information on what Germany's studies have shown so that we can see the parameters?

Mr. WEBER. Certainly.

Senator ENSIGN. OK. I appreciate that and we will do that for the record as well.

[The information referred to is retained in Committee files.]

Senator ENSIGN. Mr. Willke, if you could answer, how prepared are states today to deal with the thousands of rail and truck shipments of nuclear waste? How prepared are the states today? And what additional steps must be taken to make sure that their first responders, their emergency responders, are prepared to deal with a potential accident involving a radioactive release?

Dr. WILLKE. Senator, that is a difficult question because of the 1.2 million fire fighters in this country who do the primary response to accidents for hazardous materials, about 800,000 are volunteers, and many of these folks will go through their entire career without ever seeing a hazardous material accident.

We do our best to provide training for emergency responders, to fire fighters. We provide grants to states and tribal governments to allow for community planning for hazardous material accidents and to do training of their local fire fighters. We also work with every fire service organization, national organization, to provide training for fire fighters. We work closely with our multiple partners.

But it is also true it is very difficult to plan for the full range of hazardous material incidents that could occur, and we are lucky that we have not seen an incident that required that kind of response in the transportation of spent nuclear fuel.

Senator ENSIGN. As part of the transportation to a facility, are we requiring states to have certain types—at least certain teams trained to be able to respond? And if so, where is that training?

Dr. WILLKE. I cannot speak for the training that might be required.

Senator ENSIGN. I guess, should it be? In your opinion, should it be required?

Dr. WILLKE. There should be planning for hazardous materials incidents. We believe that all fire fighters should receive that kind of training. We are doing everything that we can to get——

Senator ENSIGN. Should it be specific to nuclear materials?

Dr. WILLKE. To the extent that materials are flowing through those communities, yes, Senator, I believe that there should be training.

Mr. SPROAT. Senator, if I can just add.

Senator ENSIGN. Yes.

Mr. SPROAT. Under the Nuclear Waste Policy Act, there is a section called 180(c) which requires the Federal Government to provide grants to State, local, county governments and first responders, including Indian tribes, specifically to provide the training for responding to radiological accidents during the transportation campaign.

Senator ENSIGN. Do you know when that is going to happen?

Mr. SPROAT. Well, as a matter of fact, we just recently put out—yes, we are about revise and put out a Federal Register notice on the process for applying for the 180(c) grants. And we have laid out a schedule of when that is to start based on the 2020 start of shipment date, and that training would start a minimum of, I believe, 6 years—5 years prior to the start of the first shipment. So that is in our overall game plan, but we are talking about——

Senator ENSIGN. Is there going to be some kind of certification process? In other words, OK, you provide a grant, you provide some training, how do we know that they are adequately trained? Is there some kind of a measuring process? I think that most police forces, most fire fighters are trained to meet a certain standard and they are certified at the end of it. Is there going to be a certification process that, yes, this fire fighter has been certified, this first responder has been certified to be able to respond to a potential nuclear accident like this?

Mr. SPROAT. I am not sure whether or not there will be a——

Senator ENSIGN. Can you get that answer for me for the record?

Mr. SPROAT. Can I take that question for the record, please?

[The information referred to follows:]

The local emergency response employer is the entity that will determine the appropriate level of training for their local responders and will determine the certifying process. While the Department of Energy will provide funding for training, State and Tribal governments will have flexibility to decide those activities for which they will request financial assistance under Section 180(c) of the Nuclear Waste Policy Act.

Senator ENSIGN. Please do.

I want to ask my colleague if he has any questions for this panel.

STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR FROM DELAWARE

Senator CARPER. Thank you, sir. Is it Mr. Chairman?

Senator ENSIGN. It is right now.

[Laughter.]

Senator CARPER. I know you are Mr. Chairman in one regard. I was not sure if you had taken over fiefdoms or not.

Senator ENSIGN. You can have that other Mr. Chairman job if you want it.

[Laughter.]

Senator CARPER. I think the people in your caucus would think it is strange for me to become their Chairman. Well, I am a bipartisan guy, but that is probably stretching it a little bit.

To our panel, thank you for joining us today. I just have one or two short questions, if I could.

The safe transportation of spent nuclear fuel depends on the interaction between a number of folks, but particularly the three agencies that we have here today, DOE, and the Department of

Transportation, and the Nuclear Regulatory Commission. You may have already discussed this before I got here, but just give me an idea how your agencies are interacting with one another.

Mr. SPROAT. If I can take a first cut at that, Senator, the relationship between the Department of Energy and DOT and NRC in the transportation realm—essentially the Department of Transportation has responsibility for setting the regulations for the safe transport on the rails and highways of hazardous waste. The Nuclear Regulatory Commission has the responsibility to set the regulations for the containers, the radioactive material containers, that we will use, design, certify, and buy to ship spent nuclear fuel and radioactive waste. So in that sense, they are our regulators in terms of setting the regulations that we have to meet for rail shipments, truck shipments, and the NRC sets the regulations that we need to meet for the containers in which we will ship the radioactive materials. That is probably a very quick, simple answer.

Senator CARPER. OK, thanks.

Mr. WEBER. I would add on NRC's behalf that certainly we are in a regulator mode with the Department of Energy now that we have accepted the Yucca Mountain license application. So it is an arm's length relationship, but I think it is a constructive relationship and we will see, as we enter into the licensing review and begin sending our requests for additional information to the Department of Energy as part of our licensing review.

With respect to our co-regulators, the Department of Transportation, I have never seen such close coordination between an agency and a Department. When my staff have questions, they are frequently on the phone with the Department of Transportation staff. These people represent the United States of America on international standards committees. They are respected around the world for their expertise in transportation safety and security. So I cannot describe for you how positive the relationship is between the agencies.

Dr. WILLKE. Mr. Chairman, PHMSA and the Department of Transportation work very, very closely with other agencies. PHMSA sets the packaging standards for shipments of all hazardous materials. In this case, we depend upon the Nuclear Regulatory Commission to set the design standards and the performance qualifications for those shipping containers.

We also work within the Department of Transportation. While we set the rules within PHMSA for all hazardous material transportation, enforcement responsibilities are shared with the Federal Railroad Administration, the Federal Motor Carrier Safety Administration, the United States Coast Guard, and the Nuclear Regulatory Commission.

We have a national program to ensure the protection from all hazardous materials. We also coordinate internationally. We work closely with the International Atomic Energy Agency on the establishment of standards across the world.

Senator CARPER. Mr. Pritchard, I am not sure what the deal is, if you are just to be here for looks or if you respond to questions or what. But I noticed they skipped right over you. I do not know if you are offended by that.

Mr. PRITCHARD. Well, we are joined at the hip, sir. We are both with the Department of Transportation and just to show you the cooperativeness that we have together.

Senator CARPER. When he spoke, I could barely see your lips move.

[Laughter.]

Senator CARPER. It was pretty impressive.

That was a pretty positive response, but are there any ways that you all think the cooperation could be facilitated or enhanced?

Mr. PRITCHARD. I think I will answer that, sir. No. We are really joined at the hip, all three of us, and we continue to work very close together.

Mr. SPROAT. I would say, Senator, as a proof of that, one of the points I tried to make in my oral testimony was that we, the country, have had over 3,000 successful spent nuclear fuel shipments already in the last 40 years with no release of radioactive material. And I think that demonstrated safety record we have is a testament to the regulatory structure that these agencies have put together and the way that the Department of Energy and the private transportation sector works with them and within those regulatory structures to assure the safety of the transportation of hazardous waste—hazardous materials on the roadways and railways.

Senator CARPER. Anybody else? Is it Mr. Willke? Are you trying to say Willke or Willke?

Dr. WILLKE. Willke.

Senator CARPER. Mr. Willke, do you want to add anything to this?

Dr. WILLKE. We have very close cooperation. We work weekly, daily, monthly in coordination with all of the various agencies, including the Transportation Security Administration on security issues.

Senator CARPER. Do you all work on weekends?

Mr. PRITCHARD. Yes, sir.

Mr. SPROAT. Yes, we do.

Senator CARPER. I was just checking.

Can I have one more minute, Mr. Chairman?

Is it Mr. Sproat?

Mr. SPROAT. Yes.

Senator CARPER. Would you take your name tag in front of you and raise it and turn it around so the audience can see it just for a second? You see, it says, H-o-n. Sproat. Right?

Mr. SPROAT. Yes.

Senator CARPER. I had a phone call. You know, we are supposed to have these do-not-call kinds of things. We are on this Do Not Call List. But I was at home one night not long ago, and the phone rings. And I looked at the number. We have caller ID, and I looked at the number and did not recognize it. It was out of state, and I thought, well, maybe I should just ignore it, but I went ahead and answered it. And the person at the other end of the phone said, I am calling Mr. Carper. I said this is Mr. Carper. And they said, Hon? Like H-o-n.

[Laughter.]

Senator CARPER. They were calling from some organization, a good charity that we had supported before. They said, Hon, we are

calling to thank you for your support. And we were just calling. It is the end of the year. We are doing our annual fund drive and wanted to ask you to help more. They said, this is Hon, isn't it? And I waited for a moment and I said, this is Hon.

[Laughter.]

Senator CARPER. Anyway, it became clear that they were interested in more money. This person gave their pitch, and I said, Hon have no money.

[Laughter.]

Senator CARPER. Not to be deterred, they came right back, same pitch, even harder. I said, Hon have no money. Not to be deterred, one more time, the third time, they came back to me again with their request. And I said, Hon have no money. Call Hon. Castle.

[Laughter.]

Senator CARPER. Congressman Mike Castle. I said, Hon. Castle have much money.

[Laughter.]

Senator CARPER. I gave them his number and said good night.

[Laughter.]

Senator CARPER. Hon. Sproat, welcome. To all of you, thank you.

Senator ENSIGN. Thank you for that story. I am not sure what it has to do with transporting nuclear waste, but I liked the story.

[Laughter.]

Senator ENSIGN. I want to thank the witnesses of this panel. We have to get going to the next panel. So I want to thank all these witnesses and call the next panel.

Sandra Schubert will testify for the Environmental Working Group, to substitute in for Ken Cook. I understand he is sick. Dr. Kevin Crowley, Senior Board Member, Nuclear and Radiation Studies Board, National Academy of Sciences. Dr. James D. Ballard, Associate Professor, Department of Sociology, California State University, Northridge. And Mr. Ed Hamberger, President, Association of American Railroads.

Since we have no Hons on the panel, we will start with Ms. Schubert and just go right down the line. And all of your full testimonies will be made part of the record.

STATEMENT OF SANDRA SCHUBERT, DIRECTOR, ENVIRONMENTAL WORKING GROUP

Ms. SCHUBERT. Thank you, Chairman Ensign, for the opportunity to testify today on the safety and security of nuclear waste transportation. As you mentioned, Ken Cook, the President of the Environmental Working Group had been asked to testify. He is very sick today and has laryngitis, so he asked me to express his regrets and step in for him.

My name is Sandra Schubert. I am the Director of Government Affairs for EWG, which is a nonprofit research organization that uses the power of information to protect public health and the environment. We have offices in Washington, D.C.; Oakland, California; and Ames, Iowa.

Since 2002, EWG has produced analyses to help educate the public about the implications of transporting radioactive waste from nuclear powerplants around the United States to Yucca Mountain, should the proposed waste repository there become operational or

nuclear plants continue to be relicensed or expand and to inform Congress, as it debates energy and climate change legislation.

Today we would like to make three points.

First, the American public's fundamental right to understand the full implications of shipping thousands of tons of extremely deadly hazardous nuclear waste across this country should be central to the Government's process for licensing Yucca Mountain, for operating any other repository for this material, and for all decisions to relicense existing nuclear reactors or build new ones. The Federal Government has not respected that right to know.

It makes no sense to generate more nuclear waste when we have not figured out what to do with the tens of thousands of tons already on hand. Our Government has ignored that common sense precaution.

The Government is rushing to approve the license application for Yucca Mountain before rudimentary, life and death questions have been resolved about transportation, storage, and a truly protective radiation public safety standard. We should not burden our children and their children with unacceptable risks.

I would like to start with one vivid illustration that we prepared that reflects Ranking Member Hutchison's home state of Texas. And it reflects clearly our point on right to know. There is a map on page 3 of the testimony. We have it reproduced up here. We have a smaller map up here of Dallas, Texas, but what you will see on the map, page 3, is the official nuclear waste transportation map buried in the Department of Energy's Environmental Impact Statement.

As you will notice, this is more cartoon than cartography. This illustration depicts only one major city in Texas, the capital, Austin, as well as facilities from which lethal radioactive waste could be shipped and a few highway designations and unnamed rail lines. Unlike on the map we have up here and which is reproduced in the testimony, you will not find Houston, Dallas, San Antonio, or any other major Texas cities on the map. However, DOE's prospective routes for shipping nuclear waste go through or near every one of these cities or suburbs or around them and countless other communities in Texas.

If folks did somehow find their way to the EIS and the proper appendix, they would not find any helpful details about how the potential routes might wind their way through towns and cities or their communities. For instance, Texans probably do not realize that 2.336 million Texans live within 1 mile of DOE's proposed Yucca Mountain routes or that there are more than 599 schools and 76 hospitals within a mile of those very same routes or that everyone agrees that there will be accidents if nuclear waste is transported as proposed.

And, I would like to shift my statement here a little bit to cite a report that talks about nuclear waste shipment accidents around the United States over the last 40 years.

According to the CRS and others, there have been 72 reported incidents involving radioactive waste shipments. This contradicts Mr. Sproat's figures where he asserted no radioactive waste accidents have occurred. According to them, in four cases, radioactive contamination has gone beyond the vehicle. In four cases, it stayed

within the vehicle. In 13 incidents, there was absolutely no release, and in 49 incidents, actual surface contamination of radiation that required cleanup. Now, mind you, this was 9,000 shipments over 40 years versus a possible 2,700 per year truck shipments to Yucca Mountain under DOE's scenario. So those are the accidents we see over 40 years under a much lighter travel load on our roadways.

What would a crash mean for a city like Houston? A moderately serious crash that would crack the casks and cause cesium leaks but not puncture or penetrate the cask could expose tens of thousands of people to radiation, dangerous levels, in less than 10 minutes. Contamination plumes would range from 300 to 750 chest X-rays equivalence and would extend up to 1 mile from the wreck. Closer in, people would be exposed to the equivalent of thousands of chest X-rays in the first hour after the accident. Based on Government data and models, we estimate that in Houston 525 people would ultimately suffer and die from latent cancers associated with this exposure. In addition, the economic costs would be enormous with the cleanup costs alone are estimated to range from $10 billion to $150 billion, depending on the accident. And this is just one scenario.

As you will notice on the charts we have put up, we tried to focus on transportation routes in major cities for members of the Commerce Committee. We can also provide, if you guys are interested, estimates of the risk for death for many of these cities, not all of them, but many of them.

Prior to recent license extensions, DOE has estimated that it would take about 10,000 rail shipments or 50,000 truck shipments of nuclear waste through our communities to fill Yucca Mountain's capacity. Yet, if all reactors receive 10- to 20-year license extensions, DOE's estimate of the total amount of waste generated in the U.S. would go up significantly, meaning additional nuclear waste shipments through our neighborhoods. If rail were the primary means of transporting the waste, which DOE is leaning toward, the 10-year license extension scenario would require more than 22,000 cross-country shipments, or about 580 per year.

Now, maybe constituents, knowing all of this, would still decide that it makes sense to put radioactive waste on their highways or they would make the decision knowing that there would still be much radioactive waste left onsite, as Senator Ensign pointed out. Or maybe residents of your states would conclude that reactors in the states or reactors in states surrounding you that might be shipping the waste through your state should operate for an additional 20 more years. Or maybe they would approve of new reactors and new license extensions. Or maybe if they really understood the ramifications of these decisions, they would not.

Our point is that the people of every state have the right to know and fully understand the implications for them of the transportation of nuclear waste in their communities, of the Yucca Mountain nuclear waste repository, the construction of new reactors before licenses go forward, the permits are granted, or the plans are approved. Decisions made hundreds of miles away will have profound implications for the shipment of high-level, deadly nuclear waste through neighborhoods for decades to come.

Thank you.

[The prepared statement of Mr. Cook follows:]

PREPARED STATEMENT OF KENNETH A. COOK, PRESIDENT, ENVIRONMENTAL WORKING GROUP

Chairman Inouye, Ranking Member Hutchison, distinguished Members of the Committee: Thank you for the opportunity to testify today on crucial issues surrounding the safety and security of the transportation of lethal, long-lived nuclear waste across the United States. My name is Kenneth Cook and I am President of Environmental Working Group (EWG), a non-profit environmental research and advocacy organization that uses the power of information to protect public health and the environment. EWG has offices in Washington, D.C.; Oakland, California; and Ames, Iowa.

Since 2002, EWG has produced analyses to help educate the public about the implications of transporting deadly radioactive wastes from nuclear power plants around the United States to Yucca Mountain, should the proposed nuclear waste repository there become operational.

Today I want to emphasize three points:

1. The American public's fundamental right to understand the full implications of shipping thousands of tons of extremely hazardous nuclear waste across this country should be central to the government's process for licensing Yucca Mountain, for operating any other repository for this material, and for all decisions to relicense existing reactors or build new ones. The Federal Government has not respected that right to know.

2. It makes no sense to generate tons more nuclear waste when we have not figured out what to do with the tens of thousands of tons already on hand. Our government has ignored that common sense precaution.

3. The government is rushing to approve the license application for Yucca Mountain before rudimentary, life and death questions have been resolved about transportation, storage, and a truly protective radiation safety standard. We should not burden our children and their children with unacceptable risks.

Let me start with a vivid illustration of my first point.

Right to Know Ignored
Government's Nuclear Waste Route Maps
Texas

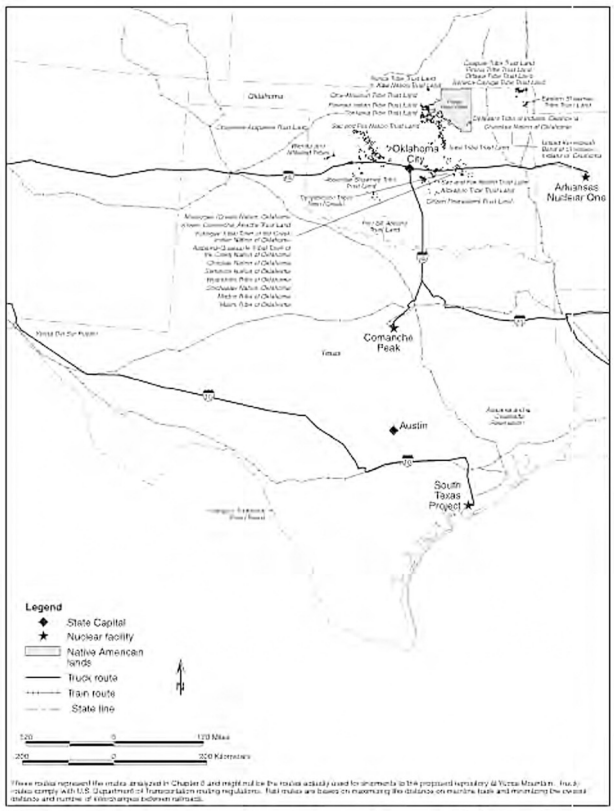
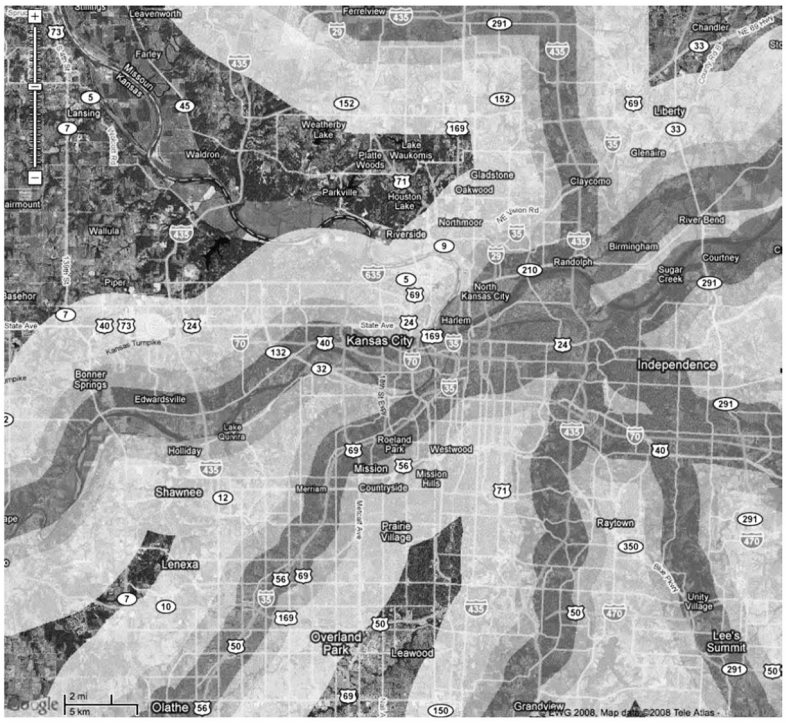


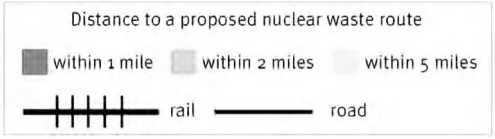
Figure J-51. Highway and rail routes used to analyze transportation impacts - Oklahoma and Texas.

Official U.S. Government maps of prospective nuclear waste shipment routes to Yucca Mountain, Nevada.
http://archive.ewg.org/reports/NuclearWaste/pdf/eis_j_OK-TX.pdf

EWG Nuclear Waste Route Map
Houston, Texas



Prospective nuclear waste shipment routes to Yucca Mountain, Nevada as depicted on Google Maps.
http://archive.ewg.org/reports/nuclearwaste/mapresults.php?&lat=35.493101786008395&lng=97.459716796875&z=10&type=on%20Satellite



Chairman Inouye, you are lucky, nuclear waste transportation is not an issue in Hawaii. However it is for nearly every other state and its citizens. Let's take a look at this map depicting Ranking Member Hutchison's home state of Texas.

This map of Texas is the official transportation map, buried in Appendix J of the Department of Energy's (DOE) Environmental Impact Statement (EIS) for the proposed Yucca Mountain nuclear waste repository.[1] It is a nuclear waste transportation route map for Texas. More cartoon than cartography, this illustration depicts only one major city in your state—the capitol, Austin. It also shows the location of facilities from which lethal radioactive waste would be shipped to Yucca Mountain if it is ever made operational, along with a few highway designations and some unnamed rail lines.

[1] The maps reproduced herein appear identical to those used in the *Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada Volume I Impact Analyses, Chapters 1 through 13,* U.S. Department of Energy, Office of Civilian Radioactive Waste Management, DOE/EIS–0250F–S1D, October 2007, Section G–11.

You will not find Houston, Dallas, San Antonio, Amarillo, Houston, or any other major Texas cities on this map of nuclear waste routes to Yucca Mountain. But the Department of Energy's prospective routes for shipping deadly nuclear reactor waste go through or near every one of those cities, or the suburbs around them, and countless other communities in Texas.

If Ranking Member Hutchison's constituents did somehow find their way to Appendix J of the EIS for Yucca Mountain, they would not find any telling details about how the potential highway or rail routes might wend their way through the towns and cities and communities of their state.

The people of Texas probably do not realize that 2,336,290 Texans live within a mile of those routes, or that there are more than 599 schools and 76 hospitals within a mile of those routes.

A nuclear transportation accident is not unlikely or unheard of. From January through June 2008, there were 1,203 train accidents. Thirteen, or 1.08 percent, of these resulted in the release of a hazardous material and the evacuation of 3,959 people. Nearly 34 percent of these were attributable to human error, more than 13.5 percent to equipment defects. Notably, these numbers do not include train-highway collisions.[2]

Everyone agrees that there will be accidents if nuclear waste is transported by train and truck through 45 states for 38 years to the repository at Yucca Mountain in Nevada. DOE predicts that there will be about 100 accidents over the life of the project. The state of Nevada predicts about 400 accidents during the same time period.

What would a crash mean for a city like Houston, TX? A moderately serious crash that would crack the cask and cause cesium leaks, but not puncture or penetrate the cask, could expose tens of thousands of people to dangerous levels of radiation. EPA's acceptable dose of radiation is 15 millirem, equal to about 1.5 chest x-rays per year. In less than 10 minutes, contamination plumes ranging from 300 to 750 chest x-rays would extend up to 1 mile from the wreck. Closer in, people would be exposed to the equivalent of thousands of chest x-rays in the first hour after the accident. Based on government data and models, we estimate that in Houston 525 people would ultimately suffer and die from latent cancers associated with this exposure. In addition, the economic costs would be enormous, with the cleanup costs alone estimated to range from $10 to $150 billion.[3]

Now, *maybe,* Texas constituents, knowing all that, would still decide that it makes sense to put lethal radioactive waste on Texas's highways and rail lines, right near their homes and through their communities, en route to Yucca Mountain. *Maybe* Texans would come to that decision knowing that plenty of waste would still remain to be dealt with at reactors in the state once Yucca Mountain is filled to its current statutory limit. *Maybe* residents of Texas would still conclude that reactors in the state, or in states to the north and east that might route waste through your state, should operate for an additional twenty years, generating more nuclear waste and more shipments for decades. *Maybe* the people of Texas would approve of new reactors being built, creating yet more waste at reactor sites, and on highways and railways, for generations to come.

Or maybe they would not approve at all if they really knew what approval meant. Texans and all other citizens have a right to know the implications of shipping waste to Yucca Mountain, or of expanding nuclear power and waste production, *before* decisions are made for them.

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[2] Federal Transportation Safety Board, Federal Railroad Administration, Office of Safety Analysis, "1.01—Accident/Incident Overview," January to June, 2008.

[3] Wiles, Richard and James R. Cox, Environmental Working Group, *Nuclear Waste Route Maps: What If A Nuclear Waste Accident Scenario in Houston, TX,* June 2002.

Government's Nuclear Waste Route Maps
Missouri

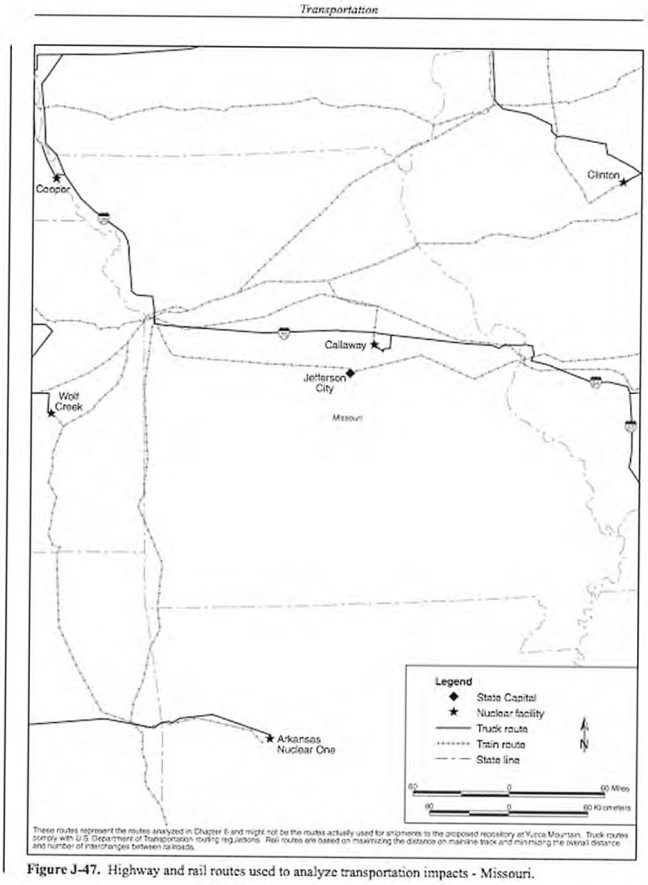
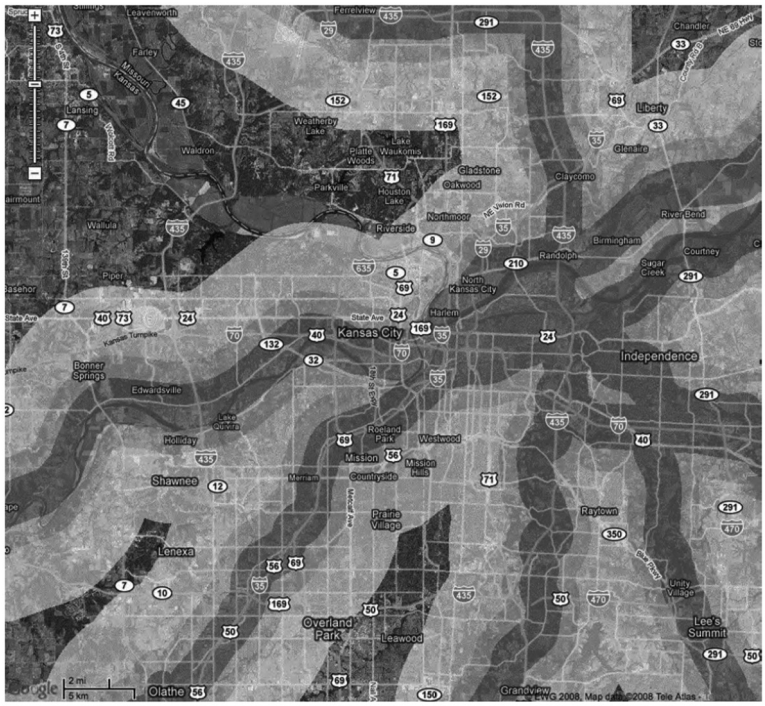


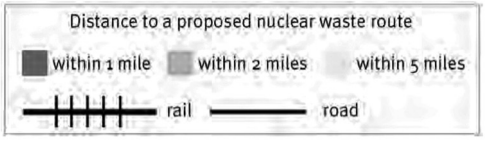
Figure J-47. Highway and rail routes used to analyze transportation impacts - Missouri.

Official U.S. Government maps of prospective nuclear waste shipment routes to Yucca Mountain, Nevada.
http://archive.ewg.org/reports/NuclearWaste/pdf/eis_j_MO.pdf

EWG Nuclear Waste Route Map
Kansas City, MO



Prospective nuclear waste shipment routes to Yucca Mountain, Nevada as depicted on Google Maps.
http://archive.ewg.org/reports/nuclearwaste/mapresults.php?&lat=35.493101786008395&lng=97.459716796875&z=10&type=on%20Satellite



Government's Nuclear Waste Route Maps

Washington, D.C.

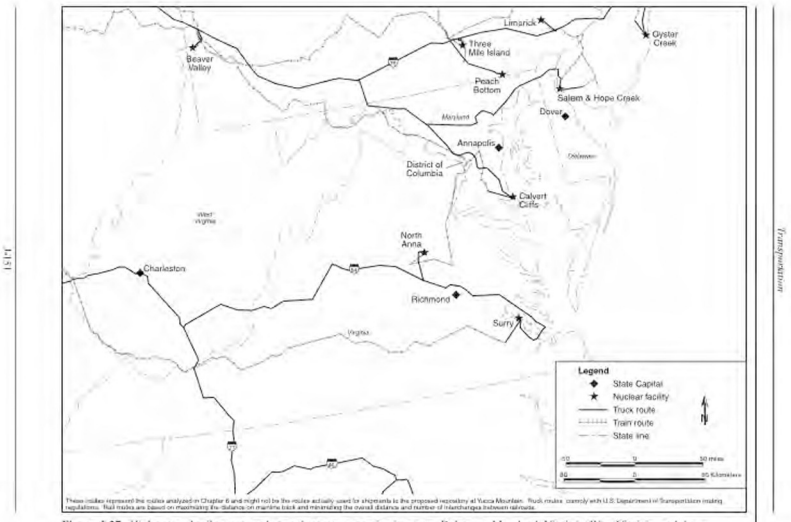


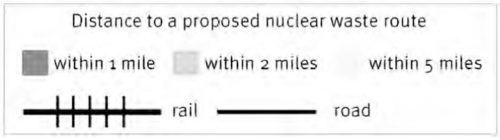
Figure J-37. Highway and rail routes used to analyze transportation impacts - Delaware, Maryland, Virginia, West Virginia, and the District of Columbia.

Official U.S. Government maps of prospective nuclear waste shipment routes to Yucca Mountain, Nevada.
http://archive.ewg.org/reports/NuclearWaste/pdf/eis_j_DE-MD-VA-WV-DC.pdf

EWG Nuclear Waste Route Map

Washington, D.C.

Prospective nuclear waste shipment routes to Yucca Mountain, Nevada as depicted on Google Maps.
http://archive.ewg.org/reports/nuclearwaste/mapresults.php?&lat=38.892101707724315&lng=77.023773193359 38&z=10&type=on%20Satellite



Government's Nuclear Waste Route Maps
California

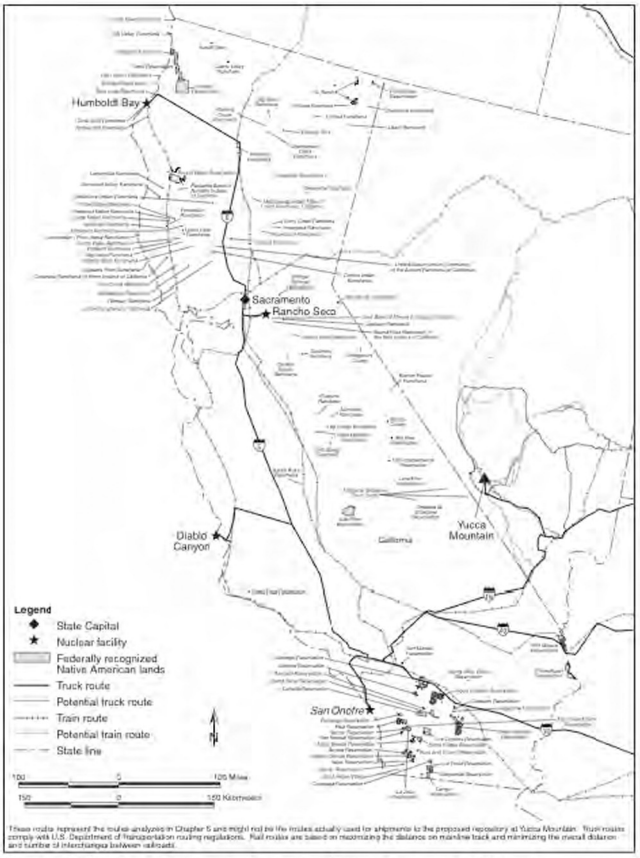
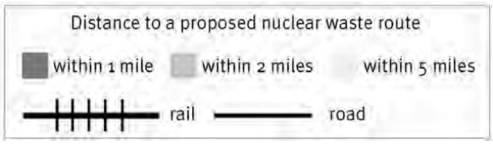


Figure J-34. Highway and rail routes used to analyze transportation impacts - California.

Official U.S. Government maps of prospective nuclear waste shipment routes to Yucca Mountain, Nevada.
http://archive.ewg.org/reports/NuclearWaste/pdf/eis_j_CA.pdf

EWG Nuclear Waste Route Map
Los Angeles, CA

Prospective nuclear waste shipment routes to Yucca Mountain, Nevada as depicted on Google Maps.
http://archive.ewg.org/reports/nuclearwaste/mapresults.php?&lat=34.052659421375964&lng=118.24310302734375&z=10&type=on%20Satellite



There is only one operating nuclear power reactor in Missouri, yet under DOE's nuclear waste transportation plan Missouri would become a major thoroughfare for the transportation of nuclear waste from around the country heading to the proposed Yucca Mountain nuclear waste dump. EWG estimates that 933,724 people live within 1 mile of the DOE's proposed routes for the shipment of high-level nuclear waste across Missouri from out of state; some 2,780,602 people live within 5 miles. Our geographic information system analysis also finds an estimated 368 schools within 1 mile of the DOE's proposed high-level nuclear waste transportation routes and 1,004 schools within 5 miles. We also estimate that 28 hospitals are within 1 mile and 55 hospitals are within 5 miles.

Again, localized, community-specific information of this sort might or might not affect the opinions of Missourians regarding the shipment through their cities and their communities of nuclear waste from other states. The only way we will know if this information is important is if we entrust it to the people of Missouri before decisions that affect them are made.

There are many examples of how government is violating people's right to know how the transportation of nuclear waste will affect them. The Department of Energy and the Nuclear Regulatory Commission have not:

- Implemented the safety recommendations of the National Academies of Sciences February 2006 report *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States;*
- Addressed the security threats posed by the transportation of spent nuclear fuel; or
- Planned for full scale physical testing of spent fuel transportation casks to determine basic safety issues, such as crash failure thresholds.

We have seen the damage that terrorists, natural disasters and failing infrastructure can wreak. Imagine the catastrophic nature of those events if nuclear waste were involved. We must address the public's questions about the safety and security of nuclear waste and its transportation through our neighborhoods.

People in every state have a right to know and fully understand the implications for them of the transportation of nuclear waste in their communities, the Yucca Mountain nuclear waste repository, and the construction of new reactors before the licenses go forward, the permits are granted, or the plans approved. Decisions made hundreds of miles away will have profound implications for the shipment of high-level, deadly nuclear waste through their neighborhoods for decades to come.

Nuclear Relicensing and Increased Transportation Risks

A little-noticed surge in relicensing of nuclear reactors will put thousands of metric tons of high-level nuclear waste on our railways and roadways. The relicensing through 2007 alone will add about 16,500 metric tons to the Nation's inventory of spent nuclear fuel, increasing transportation of radioactive waste through our neighborhoods and prolonging storage problems through the middle of the century at reactor sites across the country, effectively transforming over a dozen power plants into long term nuclear waste dumps.

Yet, nuclear power plant licenses are being extended, largely in response to the congressional approval to move forward on the proposed nuclear waste dump at Yucca Mountain, Nevada, and the administration and Congressional leaders' push for a nuclear "renaissance," and these licenses are being extended for longer than DOE has ever predicted in any of their analyses of Yucca's overall capacity.

An EWG Action Fund analysis of relicensing of nuclear facilities found that the 48 reactors at 26 nuclear power plants relicensed from 2000 to 2007 (see attached table) would generate a projected 16,500 metric tons of high-level nuclear waste over the 20-year period of their license extensions. Eighteen more reactors at 13 power plants with license extensions pending (no application to date has been denied) would add another 6,000 metric tons of waste to this, for a total of 22,500 additional metric tons of nuclear waste traveling through our communities.

Prior to recent license extensions, DOE estimated that it would take about 10,000 rail shipments or 50,000 truck shipments of nuclear waste to fill the nuclear power industry's share of Yucca Mountain, or about 90 percent of its federally limited capacity of 70,000 metric tons. Relicensing through September 2004 alone has added about 5,700 more truck shipments, or 1,050 rail shipments to that total. It would require a formal expansion of the Yucca repository to dump this nuclear waste in Nevada.

Further, if all reactors receive 20-year as opposed to 10-year extensions, DOE's estimate of the total amount of waste generated in the U.S. would increase to approximately 135,000 metric tons.

Those 20,000 metric tons would mean even more cross-country shipments of nuclear waste than are projected for DOE's worst-case scenario. In that worst-case scenario, based on 10-year license extensions, transporting our Nation's nuclear waste mostly by truck would require about 108,900 shipments over 38 years, or about 2,870 per year. If rail were the primary means of transporting the waste, the 10-year license extension scenario would require more than 22,000 cross-country shipments, or about 580 per year.[4]

The rail transport scenario does not include barge and heavy haul truck shipments from 24 nuclear reactors that lack rail access. Thousands of such shipments would be required. This analysis also does not include the proposed Nevada rail extension, the Caliente Corridor, which would be the largest rail project in decades.

[4] Halstead, Robert, Transportation Advisor, Nevada Agency for Nuclear Projects, *Testimony Before U.S. Senate Committee on Energy and Natural Resources,* May 22, 2002 (hereafter Halstead 2002).

In addition, DOE's analysis does not include the heavy haul truck shipments required within Nevada if there is no rail spur to connect to Yucca Mountain. Ten to nineteen thousand additional shipments would be required.[5]

This result of the government's push to license the proposed Yucca Mountain nuclear waste dump and its subsidization of the nuclear industry while ignoring the public health, environmental and economic costs of these activities virtually guarantees that:

- Nuclear power plants would be transformed into long-term nuclear waste dumps. The recent surge in reactor relicensing ensures that hundreds of metric tons of extremely hazardous, high-level nuclear waste would remain in place at reactors around the country, as more waste is produced long after the proposed Yucca Mountain nuclear waste dump would be full.
- The proposed Yucca Mountain nuclear waste dump would have to be expanded or a second repository opened to accommodate the additional waste. By law, Yucca Mountain is limited to 70,000 metric tons of nuclear waste, which is almost equal to the amount of nuclear waste that will be stored on-site at reactors around the country in 2010, well before any repository could be opened.
- If rail were the primary means of transporting the waste, the security and health risks inherent in these shipments are enormous, and preparedness is minimal.
- The public would be unaware of, and unprepared for, the implications of policy decisions regarding nuclear power and nuclear waste and its transportation through its neighborhoods.

People of every state have a right to know and fully understand the implications *for them* of shipping nuclear waste to the Yucca Mountain nuclear waste repository *before* shipping begins or the license for the facility goes forward. And they have the same right to know what expansion of nuclear waste generation will mean for transportation through their state if reactors around the country are relicensed for 10 to 20 additional years of operation, or new reactors are constructed. They may or may not know that decisions made hundreds of miles away will have profound implications for the shipment of high-level, deadly nuclear waste through their neighborhoods for decades to come.

Concluding Observations

I think we are all aware that the U.S. nuclear industry would not split an atom without a subsidy. They never have, and they never will.

Nuclear energy companies never hesitate to lean on American taxpayers for money to conduct nuclear research, for indemnification in the event of horrific nuclear accidents, for money to clean up industry's lethal waste and cost overruns, or for the collateral of the public's purse—loan guarantees—something the companies are seeking today to coax investors out of their sober reluctance to put money into new nuclear reactors.

But the ultimate subsidy for the nuclear industry may well be our government's scandalous failure to fully inform our own people about the potential consequence of the transportation of nuclear waste through their communities until it is too late for the people to do anything about it but accept the risk, the expense, or the unthinkable.

I thank you, Chairman Inouye, Ranking Member Hutchison, and Members of the Committee for this opportunity to testify, and I look forward to answering any questions or providing additional information at the pleasure of the Committee.

[5] Halstead 2002.

Nuclear Plants Where Reactor Licenses Have Been Extended

Plant	State	Number of Reactors	Projected Waste Per Year 1996–2011 (Metric Tons)	Additional Waste During 20-year Relicense Period (Metric Tons)
Browns Ferry	AL	3	68	1,365
Joseph M. Farley	AL	2	33	663
Arkansas Nuclear One	AR	2	29	583
Millstone	CT	2	47	936
St. Lucie	FL	2	26	524
Turkey Point	FL	2	29	573
Edwin I. Hatch	GA	2	43	865
Dresden	IL	2	37	738
Quad Cities	IL	2	29	580
Calvert Cliffs	MD	2	31	626
D.C. Cook	MI	2	41	820
Pallisades	MI	1	15	309
Monticello	MN	1	18	350
McGuire	NC	2	45	906
Brunswick	NC	2	28	560
Fort Calhoun	NE	1	10	196
Ginna	NY	1	11	225
Nine Mile Point	NY	2	39	519
Peach Bottom	PA	2	40	806
Catawba	SC	2	43	854
H.B. Robinson	SC	1	15	299
Oconee	SC	3	48	959
Summer	SC	1	19	376
North Anna	VA	2	38	766
Surry	VA	2	33	668
Point Beach	WI	2	22	434
Total		48	838	16,498

U.S. Department of Energy (DOE Yucca EIS Table A–7). 2002. Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, Appendix A, Table A–7. February 2002.

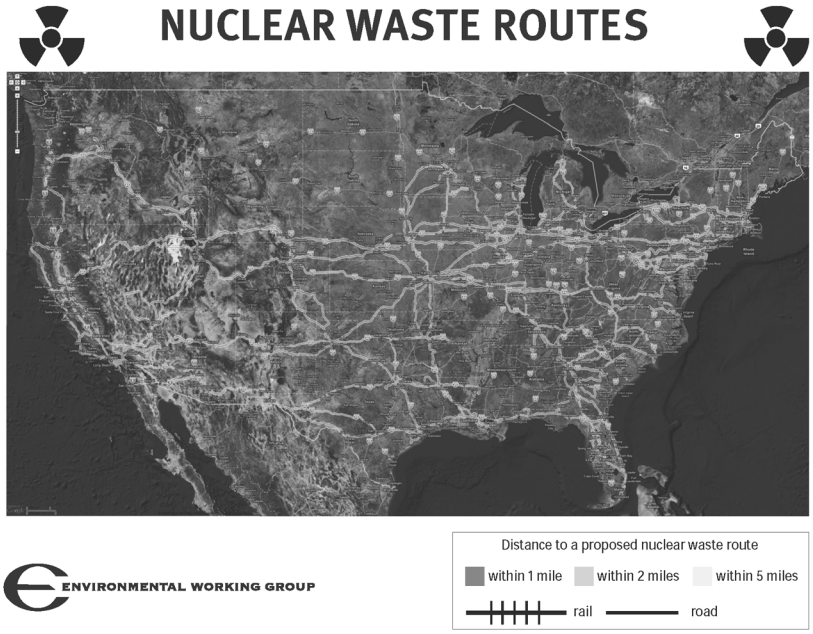
Nuclear Plants With Reactor License Extensions Pending

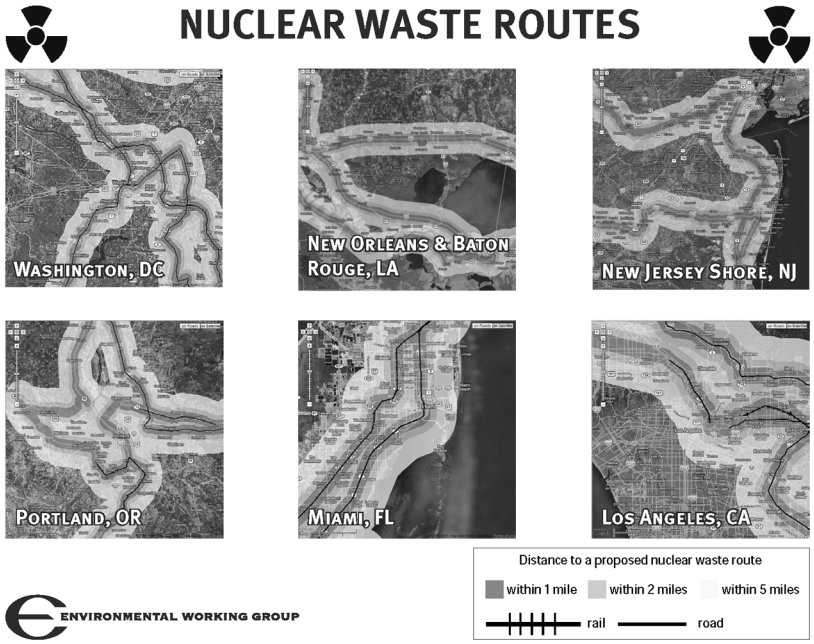
Plant	State	Number of Reactors	Projected Waste Per Year 1996–2011 (Metric Tons)	Additional Waste During 20-year Relicense Period (Metric Tons)
Vogtle	GA	2	47	931
Wolf Creek	KS	1	25	505
Pilgrim	MA	1	13	251
Prairie Island	MN	2	22	435
Harris	NC	1	16	315
Oyster Creek	NJ	1	20	406
James A. FitzPatrick	NY	1	19	384
Indian Point	NY	2	30	608
Susquehanna	PA	2	41	810
Beaver Valley	PA	2	36	726
Three Mile Island	PA	1	15	295
Vermont Yankee	VT	1	14	278
Kewaunee Power Station	WI	1	11	211
Total		18	308	6,155

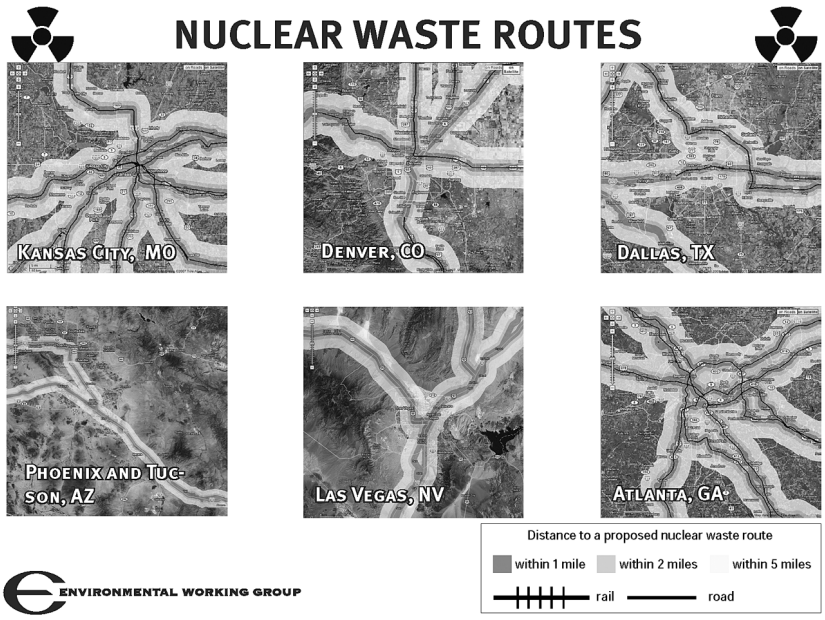
U.S. Department of Energy (DOE Yucca EIS Table A–7). 2002. Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, Appendix A, Table A–7. February 2002.

I wish to thank colleagues at the Environmental Working Group for the research and analysis underlying my testimony today: Richard Wiles, Sandra Schubert, Sean Gray, and Chris Campbell; and former colleagues John Coequyt, Jon Balivieso, and Tim Greenleaf. We are also grateful for technical assistance provided over the years by experts at the Nuclear Information And Resource Service and in particular by

Kevin Kamps, now on the staff of Beyond Nuclear. EWG is responsible for the contents of this testimony.







Senator ENSIGN. Thank you.
Dr. Crowley?

STATEMENT OF KEVIN D. CROWLEY, PH.D., SENIOR BOARD DIRECTOR, NUCLEAR AND RADIATION STUDIES BOARD, NATIONAL RESEARCH COUNCIL, THE NATIONAL ACADEMIES

Dr. CROWLEY. Good afternoon, Chairman Ensign and Senator Thune. My name is Kevin Crowley. I am the Director of the National Research Council's Nuclear and Radiation Studies Board, and I also directed two National Research Council studies that are directly relevant to the subject of this hearing. I would like to talk a little bit about some of the principal findings and recommendations from those. The reports were entitled "Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States" and "Safety and Security of Commercial Spent Nuclear Fuel Storage."

I will focus my oral summary on the key findings that relate to transportation safety, transportation security, and Yucca Mountain challenges.

With respect to key transportation safety challenges, the Committee that authored the *Going the Distance* report found that it could identify no fundamental technical barriers to the safe transport of spent fuel and high-level waste in the United States. From a technical standpoint, transport is a low radiological risk activity with manageable safety, health, and environmental consequences when conducted in strict adherence to existing regulations.

The packages that are used to transport spent fuel play a crucial role in transportation safety by providing a robust barrier to the release of radiation and radioactive material. The *Going the Dis-*

tance report noted that current international standards and U.S. regulations are adequate to ensure containment effectiveness of transport packages even in severe accidents.

However, there may be extreme accident conditions involving very long duration fires that could compromise package containment. The report recommended that the Nuclear Regulatory Commission undertake additional analyses of such accident conditions and implement operational controls and restrictions as necessary to reduce the chances that such conditions might be encountered during transport.

With respect to key transportation security challenges, the National Research Council study on Safety and Security of Commercial Spent Nuclear Fuel Storage examined the consequences of sabotage and terrorist attacks on spent fuel in storage at civilian nuclear plants. This work is relevant to spent fuel transport security because some storage packages can also be used for transportation. The unclassified report from the study notes that all storage package designs are vulnerable to some types of terrorist attacks for which releases of radioactive material would be possible, although the magnitudes of such releases are predicted to be small. However, it is important to recognize that storage packages at fixed sites, such as nuclear plants, are easier to protect from certain kinds of terrorist attacks than spent fuel packages in transport on the Nation's highways and railways.

The *Going the Distance* report recommended that "an independent examination of the security of spent fuel and high-level waste transportation should be carried out prior to the commencement of large-quantity shipments to a Federal repository or to interim storage. This examination should provide an integrated evaluation of the threat environment, the response of packages to credible malevolent acts, and operational security requirements for protecting spent fuel and high-level waste while in transport."

I have a longer write-up in my written testimony about the Yucca Mountain challenges. Let me close by just highlighting a few findings and recommendations from my longer testimony.

The *Going the Distance* report strongly endorsed DOE's decisions to ship spent fuel and high-level waste to a Federal repository by mostly rail using dedicated trains. The report recommended that DOE fully implement these decisions before commencing large-quantity shipments to the repository.

The report also recommended that DOE should identify and make public its suite of preferred highway and rail routes for transporting spent fuel and high-level waste to a Federal repository as soon as practicable to support State, tribal, and local planning.

DOE should negotiate with commercial spent fuel owners to ship older fuel first to a Federal repository or to interim storage. Should these negotiations prove to be ineffective, Congress should consider legislative remedies.

DOE should initiate transport to the Federal repository through a pilot program involving relatively short, logistically simple movements of older fuel from closed reactors to demonstrate its ability to carry out its responsibilities in a safe and operationally effective manner.

And finally, the Secretary of Energy and the U.S. Congress should examine options for changing the organizational structure of DOE's program for transporting spent fuel and high-level waste to a Federal repository to increase its chances for success.

I will stop there. I will be happy to elaborate on any of my comments during the Q&A. Thank you.

[The prepared statement of Dr. Crowley follows:]

PREPARED STATEMENT OF KEVIN D. CROWLEY, PH.D., SENIOR BOARD DIRECTOR, NUCLEAR AND RADIATION STUDIES BOARD, NATIONAL RESEARCH COUNCIL, THE NATIONAL ACADEMIES

Good afternoon, Chairman Inouye and Members of the Committee. My name is Kevin Crowley, and I am the Director of the National Research Council's Nuclear and Radiation Studies Board.[1] I also directed two National Research Council studies that are relevant to this hearing on the safety and security of spent nuclear fuel transportation:

- *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States*[2]
- *Safety and Security of Commercial Spent Nuclear Fuel Storage*[3]

Both of these reports were published in 2006. The latter report, which has classified and unclassified versions, was the product of a congressionally mandated study. That study examined the safety and security of dry storage of spent nuclear fuel at civilian nuclear power plants. Some of the results of that study have informed my comments on transportation security.

My testimony is provided in three parts: transportation safety challenges, transportation security challenges, and the challenges associated with transportation of spent fuel to the proposed repository at Yucca Mountain, Nevada.

Transportation Safety Challenges

My comments on the safety[4] challenges associated with transporting nuclear waste will focus specifically on the transportation of spent nuclear fuel generated by civilian nuclear power plants. Spent fuel is highly radioactive and can cause severe harm to humans and the environment, if not properly managed. Immediately after its discharge from a power reactor, for example, the radiation emitted from a single spent fuel assembly would be lethal to a nearby unshielded person for exposure periods on the order of minutes. Spent fuel becomes less radioactive with time, but even after several years of storage it is still highly radioactive and can cause both immediate (*i.e.,* radiation sickness and death) and delayed (*e.g.,* cancer) effects in exposed populations if not properly managed.

There are at least three factors that promote the safety of spent fuel transportation in the United States:

- Storage before shipping: Civilian spent fuel must be stored for at least a year before it can be transported, and current industry practice is to store this fuel for at least 5 years before transporting it. This provides time for radioactive decay in the spent fuel, which helps to reduce its hazard.
- Transport packages: Spent fuel is transported in *packages* (also referred to as *shipping casks*) that are designed to shield the radiation that is emitted by the fuel and also to prevent the release of radioactive material, even in severe accidents.
- Conduct of transport operations: There are strict regulatory requirements for selection of shipping routes, advance notification of state authorities before shipments are made, and for shipping operations.

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[1] The National Research Council is the operating arm of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine of the National Academies, chartered by Congress in 1863 to advise the government on matters of science and technology. The Nuclear and Radiation Studies Board is responsible for oversight of National Research Council studies on safety and security of nuclear materials and waste.

[2] This report is available online at *http://www.nap.edu/catalog.php?record_id=11538.*

[3] The unclassified report is available online at *http://www.nap.edu/catalog.php?record_id=11263.*

[4] Safety refers to measures taken to protect spent fuel and high-level waste during transport operations from failure, damage, human error, and other inadvertent acts.

The National Research Council's *Going the Distance* report provides a detailed discussion and analysis of the safety of spent fuel transportation, focusing on the design and testing of packages used to transport spent fuel and on the historical record of spent fuel shipments. Based on this analysis, the expert committee[5] that conducted this study found that it

> ". . . could identify no fundamental technical barriers to the safe transport of spent nuclear fuel and high-level radioactive waste in the United States. Transport by highway (for small-quantity shipments[6]) and by rail (for large-quantity shipments) is, from a technical viewpoint, a low-radiological-risk activity with manageable safety, health, and environmental consequences when conducted in strict adherence to existing regulations. However, there are a number of social and institutional challenges to the successful initial implementation of large-quantity shipping programs that will require expeditious resolution. . . . Moreover, the challenges of sustained implementation should not be underestimated."

I want to emphasize that this finding focused on the technical aspects of spent fuel and high-level waste transportation—for example, the design, fabrication, and maintenance of the packages and conveyances used for transporting spent fuel and the conduct of transportation operations. This finding is predicated on the assumption that these technical tasks are being carried out with a high degree of care and in strict adherence to regulations. The finding also is based on an assessment of past and present transportation programs and would apply to future programs only to the extent that they continue to exercise appropriate care and adherence to applicable regulations. Continued vigilance by all parties involved in these transportation programs, including planners, shippers, and regulators, will be required to ensure that transportation operations in the United States continue to be conducted in a safe manner, especially if and when the large-quantity shipping program to Yucca Mountain is initiated.

The packages that are used to transport spent fuel play a crucial role in transportation safety by providing a robust barrier to the release of radiation and radioactive material. In fact, the robust design of these packages helps to minimize the impacts of human error on transport safety. The committee that conducted the *Going the Distance* study found that current international standards and U.S. regulations are adequate to ensure package containment effectiveness[7] during both routine transport and in severe accidents. However, the study committee noted that recently published work suggests that there may be a very small number of extreme accident conditions involving very long duration fires[8] that could compromise package containment effectiveness. The study committee recommended that the U.S. Nuclear Regulatory Commission (USNRC) undertake additional analyses of very long duration fire scenarios that bound expected real-world accident conditions. Based on the results of these investigations, the study committee also recommended that the USNRC implement operational controls and restrictions on spent fuel and high-level waste shipments as necessary to reduce the chances that such conditions might be encountered in service. The study committee further recommended that transportation planners and managers undertake detailed surveys of transportation routes to identify and mitigate the potential hazards that could lead to or exacerbate extreme accidents involving such fires.

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[5] Committee on Transportation of Radioactive Waste. Dr. Neal Lane, a physicist at Rice University and former director of the National Science Foundation and Presidential science advisor, chaired this study.

[6] The *Going the Distance* report identified two general types of transportation programs, small-quantity shipping programs and large-quantity shipping programs. The former involve shipment on the order of tens of metric tons of spent fuel or high-level waste, while the latter involve shipment on the order of hundreds to thousands of metric tons. The program to transport spent fuel to the proposed repository at Yucca Mountain would be an example of a large-quantity shipping program.

[7] That is, the ability of a transportation package to contain its radioactive contents and maintain its radiation shielding effectiveness during routine use and under severe accident conditions.

[8] The USNRC requires that packages be designed to maintain containment effectiveness in a 30-minute fire that is fully engulfing. A very long duration fire is a fire that burns for much longer periods, for example, hours to days.

Transportation Security Challenges

Let me now turn to the security[9] of spent fuel transportation. Many of the regulatory requirements that are in place to promote the safety of spent fuel transport also help to promote security. For example, the robust shipping packages that are used to protect spent fuel in the event of a severe accident would also help to protect spent fuel against some types of sabotage and terrorist attacks. There are additional regulatory requirements that also help to promote security of spent fuel shipments: for example, the USNRC conducts route inspections to identify potential security vulnerabilities as part of its route approval process; it has established requirements for armed escorts when shipments pass through highly populated regions; and it has established other requirements for equipment security and communications. Some of these regulatory requirements were revised after the September 11, 2001, terrorist attacks, and some specific requirements have not been disclosed to the public to protect national security.

However, transportation security differs from transportation safety in at least one important respect: safety problems arise from human error and equipment malfunctions that are amenable to quantitative analysis, whereas security problems arise from intentional malevolent acts that generally do not lend themselves to such analysis. Transportation safety analyses, for example, rely heavily on the historical record for shipping other types of hazardous materials. This record allows analysts to identify severe accident scenarios that might be a concern for spent fuel transport—for example, train collisions or derailments that expose shipping packages to large impact forces or severe fires—and also provides analysts with reliable data on the frequency of occurrence of such accidents. These accident scenario and accident frequency data can be used to quantitatively model the safety consequences of severe accidents involving spent fuel.

There is no comparable historical record that can be used to develop quantitative estimates of sabotage or attack scenarios or their frequency of occurrence. Instead, analysts must rely on expert judgments about the threat environment and terrorists' access to technical means and opportunity for attacking or sabotaging spent fuel shipments. I should note that this security challenge is not unique to spent fuel transportation, but is also faced by owners and operators of other critical infrastructure.

A great deal of work has been carried out in the United States and in some other countries to understand the potential consequences of sabotage and terrorist attacks on spent fuel shipments. Most of this work is classified or otherwise restricted from public release. The National Research Council study on *Safety and Security of Commercial Spent Nuclear Fuel Storage* examined some of the relevant work that has been carried out by Sandia National Laboratories and others to estimate the consequences of sabotage or terrorist attacks on spent fuel being stored at civilian nuclear plants.[10] This work is relevant to spent fuel transport security because some of the packages that are used to store spent fuel at civilian nuclear plants can also be used for transportation. The study committee's[11] detailed analyses of the consequences of various terrorist attack scenarios are classified; however, the study committee's unclassified report notes that all storage cask designs are vulnerable to some types of terrorist attacks for which releases of radioactive material would be possible, although the magnitudes of such releases are predicted to be small. However, it is important to recognize that storage casks at fixed sites such as nuclear plants are in principle easier to protect from certain kinds of terrorist attacks than spent fuel packages in transport on the Nation's highways and railways.

The National Research Council's *Going the Distance* study was organized before the September 11, 2001, terrorist attacks on the United States. It was focused primarily on the safety of spent fuel and high-level waste transport because this issue was receiving the most public attention when the study was organized. Once the study was begun, however, it soon became clear that transportation security had established itself in the public's consciousness as a top concern along with transportation safety. The study committee was not able to conduct an in-depth review of transportation security because of information access constraints. However, the study committee found that "malevolent acts against spent fuel and high-level waste shipments are a major technical and societal concern, especially following the Sep-

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[9] Security involves measures taken to protect spent fuel and high-level waste against sabotage, attacks, and theft while it is in transport.

[10] This study examined both wet storage of spent fuel in pools and dry storage in casks. My comments in this testimony are focused only on dry storage.

[11] Committee on Safety and Security of Commercial Spent Nuclear Fuel Storage. The committee was chaired by Dr. Louis Lanzerotti, a geophysicist and member of the National Academy of Engineering.

tember 11, 2001, terrorist attacks on the United States." The study committee also recommended that

> "An independent examination of the security of spent fuel and high-level waste transportation should be carried out prior to the commencement of large-quantity shipments to a Federal repository or to interim storage. This examination should provide an integrated evaluation of the threat environment, the response of packages to credible malevolent acts, and operational security requirements for protecting spent fuel and high-level waste while in transport. This examination should be carried out by a technically knowledgeable group that is independent of the government and free from institutional and financial conflicts of interest. This group should be given full access to the necessary classified documents and Safeguards Information to carry out this task. The findings and recommendations from this examination should be made available to the public to the fullest extent possible."

I want to emphasize that this recommendation was not made because the study committee had specific knowledge of vulnerabilities of spent fuel shipments to sabotage or terrorist attacks. Instead, it was motivated primarily by concerns that were expressed to the study committee about whether such shipments could be made in a secure fashion in spite of reassurances from Federal agencies. The study committee recognized that the Federal agencies were in a difficult position on this issue because as much as they might like to share security-related information that might help to inform the public, there were legitimate national security reasons for not doing so. The study committee judged that an independent review would help to improve the technical soundness of the agencies' security programs for spent fuel transportation and also help to reassure the public that the agencies' programs were proceeding on a sound technical basis.

Transportation Challenges for Yucca Mountain

The primary challenges for the Yucca Mountain transportation program arise from at least three factors: the large number of shipments that are planned; the two-decade-plus-time period over which the transportation program must be operated in a safe and secure manner; and the long lead times and large expenditures that will be required to put the necessary transportation infrastructure in place. The National Research Council's *Going the Distance* report noted that the planned number of rail shipments to a repository at Yucca Mountain under the Department of Energy's (DOE's) "mostly rail" scenario is approximately 18 times the number of rail shipments that have occurred in the United States between 1964 and 2004.[12] In other words, previous spent fuel transport experience in the United States is small compared with the numbers of shipments that will be needed to move spent fuel and high-level waste to a Yucca Mountain repository.

The National Research Council committee that authored the *Going the Distance* report provided several findings and recommendations for improving the Yucca Mountain transportation program; these are summarized below:

- The study committee strongly endorsed DOE's decisions to ship spent fuel and high-level waste to the Federal repository by "mostly rail" using dedicated trains. This approach would reduce routine radiological exposures; provide for greater physical separation from other vehicular traffic and reduced interactions with people along transportation routes; and simplify operational logistics. It is also the approach that is preferred by the public. The study committee recommended that DOE fully implement this approach by completing construction of the Nevada rail spur and making other necessary arrangements before commencing large-quantity shipments to the repository. The study committee also recommended that DOE examine the feasibility of further reducing its needs for cross-country truck shipments[13] of spent fuel.
- DOE should identify and make public its suite of preferred highway and rail routes for transporting spent fuel and high-level waste to a Federal repository as soon as practicable to support state, tribal, and local planning, especially for emergency responder preparedness. DOE should follow the practices of its for-

[12] The Yucca Mountain EIS noted that DOE plans to make up to 9600 rail shipments of spent fuel and high-level waste to the repository. The *Going the Distance* study estimates that about 540 rail shipments of spent fuel were made in the United States between 1964 and 2004. The actual number of rail shipments to Yucca Mountain would depend on how DOE conducts its transport operations.

[13] Even under the "mostly rail" scenario, DOE estimated in its Yucca Mountain EIS that about 1100 truck shipments would be made to the repository.

eign research reactor spent fuel transport program of involving states and tribes in these route selections.[14]

- DOE should negotiate with commercial spent fuel owners to ship older fuel first to a Federal repository or to Federal interim storage.[15] Should these negotiations prove to be ineffective, Congress should consider legislative remedies. Within the context of its current contracts with commercial spent fuel owners, DOE should initiate transport to the Federal repository through a pilot program involving relatively short, logistically simple movements of older fuel from closed reactors to demonstrate its ability to carry out its responsibilities in a safe and operationally effective manner.
- DOE should begin immediately to execute its emergency responder preparedness responsibilities defined in Section 180(c) of the Nuclear Waste Policy Act. The study committee recommended several approaches for carrying out this recommendation.
- DOE, the Department of Homeland Security, Department of Transportation, and USNRC should promptly complete the job of developing, applying, and disclosing consistent, reasonable, and understandable criteria for protecting sensitive information about spent fuel and high-level waste shipments. They should also commit to the open sharing of information that does not require such protection and should facilitate timely access to such information, for example, by posting it on readily accessible websites.
- DOE should take early and proactive steps to establish formal mechanisms for gathering high-quality and diverse advice about social risks[16] and their management on an ongoing basis.
- The Secretary of Energy and the U.S. Congress should examine options for changing the organizational structure of DOE's program for transporting spent fuel and high-level waste to a Federal repository to increase its chances for success. The following three alternative organizational structures, which are representative of progressively greater organizational change, should be examined: (1) a quasi-independent DOE office reporting directly to upper-level DOE management; (2) a quasi-government corporation; or (3) a fully private organization operated by the commercial nuclear industry.

The study committee found that successful execution of DOE's program to transport spent fuel and high-level waste to a Federal repository will be difficult given the organizational structure in which it is embedded, despite the high quality of many program staff. As currently structured, the program has limited flexibility over commercial spent fuel acceptance order; it also has limited control over its budget and is subject to the annual Federal appropriations process, both of which affect the program's ability to plan for, procure, and construct the needed transportation infrastructure. Moreover, the current program may have difficulty supporting what appears to be an expanding future mission to transport commercial spent nuclear fuel for interim storage or reprocessing. In the study committee's judgment, changing the organizational structure of this program would improve its chances for success.

This concludes my testimony to the Committee. Thank you for the opportunity to testify on these important issues. I would be happy to elaborate on any of my comments during the question and answer period.

Senator ENSIGN. Thank you.
Dr. Ballard?

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[14] The *Going the Distance* report contains a detailed discussion of routing regulations for spent fuel shipments.

[15] Shipping older fuel first would help to reduce transportation worker exposures to radiation from the spent fuel and high-level waste shipments.

[16] Social risks arise from social processes and human perceptions. Social processes shape the communities in which people live by, for example, influencing choices about where to purchase or rent a home, where to work, and where to send children to school. Social perceptions can have a strong influence on peoples' behavior, whether or not such perceptions are an accurate picture of reality.

STATEMENT OF JAMES DAVID BALLARD, PH.D., ASSOCIATE PROFESSOR, DEPARTMENT OF SOCIOLOGY, CALIFORNIA STATE UNIVERSITY, NORTHRIDGE (CSUN); DIRECTOR, CSUN INTELLIGENCE COMMUNITY CENTER ACADEMIC EXCELLENCE (IC–CAE); CONSULTANT, NUCLEAR WASTE PROJECT OFFICE, STATE OF NEVADA

Dr. BALLARD. Thank you, Mr. Chairman.

I am a professor at California State University, Northridge. My specialty is terrorism. I am in the Sociology Department where I run a center funded by the ODNI, which is to help our students do analysis of just such projects as these. I have been engaged in this enterprise of looking at Yucca Mountain security risks for 14 years and have worked with the State of Nevada over that time.

I thank you very much for allowing me to come here today.

I do have three points that I would like to make, and these reflect my own personal opinions and not those of any of the agencies that I may have affiliation with.

First, number one, the Yucca Mountain project as it is conceived presents a target-rich environment and we should consider the shelter-in-place option that Senator Reid discussed earlier. The Yucca Mountain transportation program is a security risk in and of itself. This is a large-scale Federal program that will draw attention from a wide variety of adversaries. Adversaries that may not exist for many of the other hazardous materials that are transported daily would possibly be interested in these shipments. Yucca Mountain will necessitate the movement of large numbers of shipments over an extended period of time. It allows the adversary to chart the movement of these shipments in a predictable way. It is exacerbated by choices that agencies like the DOE makes. For example, decisions to allow hotter fuel to be shipped may increase the radiological consequences of an attack. And it will entail lengthy shipment routes that average over 2,000 miles since many of the shipment origin sites are east of the Mississippi.

The safety and security program that DOE will need to engage in for Yucca Mountain must face one fact. The shipments will provide this target-rich environment, which means we need to consider the totality of the shipment routes as the battle space, the attackers as potential adversaries with their choice of weapons and tactics, the shipments themselves as poorly defended, high-value, symbolic targets, and the perpetuation of an attack against these shipments being a highly symbolic statement by the adversaries.

Spent nuclear fuel is safe where it exists. Placing them in the transportation corridors increases risk from a variety of means, accidents, human-initiated events, and so on. And it would be better to shelter them in place until such time that we have better options.

Point number two. There are a series of existing issues that many of the panelists have alluded to and I would like to summarize for the panel.

First of all, shipping older fuel first is a primary consideration that we should insist on.

Second, shipments should be mostly rail, but truck shipments are necessary to complete the task given the physical limitations of the origin sites and the current physical limitations of Yucca Mountain.

We need to use dual-purpose casks, dedicated trains.

We need to conduct full-scale cask testing, not just regulatory testing, but extra-regulatory testing.

We need to engage in a meaningful national level transportation NEPA process, including the selection of a rail spur, if that is the decision to go ahead with for Yucca Mountain.

We need to use the WEIB "straw man" routing process.

We need to start the section 180(c) program rulemaking.

We need to allow for State regulatory enhancements both for the safety but also public perception.

We need to rethink the assumptions about terrorism and sabotage in light of 9/11.

These issues constitute the most basic foundations for the development of a preferred transportation system. Since today's hearing is directly related to the last issue, the balance of this testimony will deal with that.

So, point three, human-initiated events and systematic risk assessment looking at these from a different perspective. The sabotage-related attacks in areas evaluated in NRC and DOE analyses have changed little over the decades and assume a single spent fuel shipping cask is attacked at one location by one group of attackers and typically using one weapon. The basic analyses also assumed that the attack breaches the cask and releases a small fraction of the contents. The threat environment has changed since the start of the Yucca Mountain debates decades ago. Yet, DOE has failed to adopt an alternative perspective on the risk of these attacks.

They can engage in a different process to identify those risks and perhaps bring them into the regulatory framework. First and foremost, we need to engage in a meta-analysis of the risk as defined across the world. Second, we need to develop a systematic, multi-level assessment process for these risks. That includes existing methodologies like security surveys, risk management techniques, the design basis threat, but most importantly, we need to consider the use of adversarial vulnerability assessments.

One critical omission for all three of the techniques I just mentioned is to bring the motives, mind set, and creativity of the adversary into the risk equation. To accomplish that task, we need to do a mental coordinate transformation. This means that when assessing the risk for spent nuclear fuel transportation and the infrastructure to move that material, it is necessary to think like the perpetrators, not like security professionals, not like energy company officials, and not like oversight agencies. AVA is one proven method that can help accomplish that task.

When we are done with this, using all four of these techniques, we can create a matrix of potential threats against these shipments. In my written testimony, there is a mock matrix that we can refer to.

Take-aways from today, or a conclusion.

Point number one, Yucca Mountain transportation is risky and will present a target-rich environment for our adversaries. The shipments are symbolically important and represent a radiologically significant target. The solution is to shelter the shipments in place at their sites of origin. As noted by the NRC, energy industry

officials, and others, they are safe and secure at those facilities. Why expose these wastes to risk if we do not have to?

Point number two, DOE has systematically neglected to address the laundry list of concerns brought forth by stakeholders. These actions increase the likelihood of attacks, the consequences of those attacks, and the resultant social dislocations if these attacks succeed. The solution here is to compel the DOE to engage in a meaningful, national level NEPA process that addresses these stakeholder concerns and that will be documented over the decades of Yucca Mountain transportation.

Last point, DOE, in consultation with stakeholders, should engage in a systematic assessment of risk using the AVA process. The solution here is just to do this and will allow the DOE to avoid the potentially fatal flaw of being reactive to threats and become more proactive in relationship to human-initiated events. In the post-9/11 world, almost all Federal agencies with a significant homeland security role have had to rethink their assumptions on how best to serve the public interest. The DOE must likewise abandon the engineering-based bureaucratic paradigm they hold dear to reconsider how to identify risk from the perceptions and ideas of the adversary.

In conclusion, Yucca Mountain transport is risky, movement of radioactive materials potentially dangerous, and failing to recognize human-initiated events in a post-9/11 world can be deadly. Alternatives exist, alternatives like shelter-in-place, truly listening to the stakeholders, and using systematic risk analysis.

Thank you very much, Mr. Chairman.

[The prepared statement of Dr. Ballard follows:]

PREPARED STATEMENT OF JAMES DAVID BALLARD, PH.D., ASSOCIATE PROFESSOR, DEPARTMENT OF SOCIOLOGY, CALIFORNIA STATE UNIVERSITY, NORTHRIDGE (CSUN); DIRECTOR, CSUN INTELLIGENCE COMMUNITY CENTER ACADEMIC EXCELLENCE (IC–CAE); CONSULTANT, NUCLEAR WASTE PROJECT OFFICE, STATE OF NEVADA

Introduction

Mr. Chairman and distinguished Members of the Committee, thank you for asking me to testify at these hearings. My name is Dr. James David Ballard and I am currently employed as an Associate Professor of Sociology at California State University, Northridge (CSUN).[1] As part of my academic appointment I am also the campus director for the ODNI funded Intelligence Community Center for Academic Excellence (IC–CAE) program.[2] In an effort toward full disclosure, you should also know that I have had an on-going relationship as a consultant to the state of Nevada Agency for Nuclear Projects (NANP) since 1995.[3]

Over the last fourteen years I have been privileged to specialize in studying issues associated with human initiated events, defined as terrorism, sabotage, etc. that may impact transportation efforts for the proposed Yucca Mountain shipments of spent nuclear fuel (SNF) and high level radioactive wastes (HLRW). The statements made today reflect my own individual opinions and are not necessarily those of any of these institutions I am associated with, nor do my comments necessarily reflect the opinions of my co-authors, research teams and/or colleagues.

The foundations of my testimony arise from fourteen years of study on the issues surrounding potential terrorist attacks against shipments. During that time I have been privileged to be part of several multi-disciplinary teams of researchers that have studied the risk of terrorism attacks on nuclear waste shipments to the proposed Yucca Mountain storage facility.[4] In particular, we as a body of scholars, study the changing nature of terrorism and the terrorist tactics that could be employed against radioactive waste shipments. As part of this on-going effort we have identified a range of risks associated with transportation of these materials. On two

previous occasions I have testified before the House/Senate on the issues we discuss today.[5]

I appreciate the opportunity to brief this body on our work regarding the potential of terrorism attacks against the shipments of spent nuclear fuel (SNF) and high-level radioactive wastes (HLRW) that may be sent to the proposed Yucca Mountain facility. I hope the following discussion will help you and the agencies involved in regulating the potential shipments to better understand the value of a social scientific perspective on SNF transportation. I will begin by discussing an issue that has been neglected in the debates since it was introduced nearly 10 years ago—the target rich environment that these shipments represent. Second, I will concentrating on several other pressing issues not yet addressed in any adequate form by the DOE relative to the Yucca Mountain project. Following this summary of neglected issues, this testimony will offer a systematic risk assessment protocol that can help overcome some of the deficiencies that the DOE has in their DEIS, EIS and SEIS documents, one critical basis of their planning efforts to date on Yucca Mountain shipments. Last, this presentation will suggest several ways that you may wish to review the transportation planning from an alternative perspective than that presented by the DOE. These alternatives are a way you may gain insightful evidence into the terrorism related threats these shipments face.

Target Rich Environment

The DOE has for decades tried to find a way to manage the terrorism risks associated with the proposed Yucca Mountain project with little overall programmatic success. Over that extended time-frame the expenditures of rate payer and taxpayer funding for this agency and its efforts have produced some less than stellar social scientific results with respect to the risks of human initiated events. Make no mistake, what we take about when discussing the transport of SNF and HLRW shipments are potentially very dangerous cargos and highly symbolic targets. They are a danger to the transportation infrastructure, to the public health and to the long term economic viability of the location(s) where an accident and/or terrorist attack may transpire. This is a social fact, no matter the rhetoric used by the industry and/or DOE to obscure this reality. Listen carefully to what is said and ask yourselves if it designed to obscure the issues from law makers, the public and the many stakeholders who are concerned about the shipment campaign necessary to stock the proposed Yucca repository.

In contrast to the DOE and nuclear industry perspectives, what the critics say is typically designed to see any Yucca Mountain transportation program conducted in a manner consistent with NEPA requirements. That is, the suggestions made by these critics compel the DOE to follow the spirit and letter of this law when looking at the transportation planning for this particular large scale Federal program.

One critical issue typically neglected by the DOE is the recognition of this shipment campaign as a danger to the public. In other words, any Yucca Mountain transportation program that becomes necessary to transport the Nation's stockpiles of highly radioactive waste is a security risk in and of itself. What DOE seemingly fails to understand is that this large scale Federal program will draw the attention of a wide variety of adversaries because of its symbolic value—briefly it is nuclear, it is Federal and it is controversial. The choice of a geographic location far distant from the production sites where SNF and HLRW are generated assists the adversaries since it:

- Necessitates the movement of large numbers of shipments.
- Allows for the adversary to chart movement of these shipments in a predictable way.
- Is exacerbated by choices the DOE makes. For example, decisions that allow for hotter fuel, thus higher potential harm, to be sent along these predictable corridors.
- Will entail lengthy shipment routes that average over 2,000 miles of open, unprotected terrain where an adversary can pick and choose the attack site.

Collectively these and other avoidable/manageable risks can be discussed as constituting a target rich environment.[6] The idea of a target rich environment is derived from military parlance. In this case we should consider:

- The totality of the shipment routes as the battle space.
- The attackers as potential adversaries with their choice of weapons and tactics.
- The shipments themselves as poorly defended, high value, symbolic targets.
- The perpetration of an attack against these shipments being a highly symbolic statement by the adversaries.

Under this definitional schema the DOE's transportation choices become increasingly important. This issue alone may suggest that sheltering the wastes in place,[7] at their point of origin, may be a more optimal safety and security strategy since the highly radioactive wastes will be protected from entering the target rich environmental battle space. The next section of this testimony reviews ten more critical issues that should prompt reconsideration by this body when deliberating the logic of the Yucca Mountain project and its potential to present a target rich environment to adversaries, both foreign and domestic.

Pressing Issues

Recently Nevada summarized a top ten list of issues of concern during a presentation at the foremost nuclear industry conference, Waste Management 2008.[8] Since enactment of the NWPAA, and adoption of Assembly Concurrent Resolution 8 by the Nevada Legislature in 1987, NANP has consistently made recommendations to DOE regarding transportation safety and security, including many in this listing. The top ten measures are summarized below.

1. *Ship the Oldest Fuel First.* Nevada has recommended that DOE ship the oldest SNF first. This recommendation is supported by NAS and GAO since they also recommend shipping older fuel first. For example, shipping SNF that has been "aged" 50 years out of reactor, compared to shipping 5-year-cooled SNF, could reduce radiological hazards significantly and assist in lowering the risks of human initiated events.

2. *Shipments should be by Rail.* Nevada has recommended that DOE utilize rail as the preferred mode of transportation, while acknowledging the serious impediments to developing rail access to Yucca Mountain and from 24 of the 76 shipping sites. Based on shipping site current capabilities, the share of SNF that could realistically be shipped by rail may be 65–75 percent, not the 90 percent projected by DOE. Thus, DOE must first admit to the realities of the proposed shipment campaign and start planning for large numbers of truck shipments under the "mostly rail" shipment scenario. This would entail a serious reconsideration of the safety and security requirements necessary to protect shipments.

3. *Use Dual-Purpose Casks.* Nevada has recommended that DOE base its transportation system on use of dual-purpose (transportable/storage) casks of a standardized design, with a range of capacities resulting in loaded cask weights of about 125, 100, and 70 tons. In 1995, Nevada endorsed a previous DOE transportation plan that would have used a multi-purpose canister (MPC) system for transport and storage. DOE's current proposal to use the TAD (Transport, Aging and Disposal) canister system does not fully address this issue. This operational choice by the DOE may actually complicate and further constrain the transportation system.

4. *Use Dedicated Trains.* Nevada has recommended that DOE use dedicated trains for all rail shipments. Until DOE commits to only using dedicated trains, DOE routing studies and risk analyses must evaluate use of both dedicated and general freight rail shipments. This policy choice by the DOE adds to the complexity of any analysis, but more importantly without the commitment of dedicated trains, the safety and security of shipments may be compromised since securing SNF/HLRW shipments in general freight poses significant challenges and greatly increases the risk of terrorism or sabotage during transport.

5. *Commit to Meaningful Cask Testing.* Nevada has recommended that DOE and/or NRC conduct a meaningful full scale cask testing program. DOE or NRC should conduct full-scale regulatory tests on each cask design (or in cases of similar designs, test one cask from each representative grouping). DOE or NRC should also conduct a combination of extra-regulatory, full-scale testing, scale model testing, component testing, and computer simulations to determine cask failure thresholds. In addition, DOE and/or NRC must ensure meaningful stakeholder participation in all aspects of the cask testing program. Last, DOE and/or NRC should also couple this testing with new insights into the potential for human initiated events like sabotage and terrorism (extra regulatory testing). Understanding the potential releases from casks that could result from a human initiated event rests on knowing how these casks react to a variety of attack conditions.

6. *Use a meaningful NEPA process for all transportation activities.* Nevada has recommended that DOE use a credible National Environmental Policy Act (NEPA) process to select a preferred Yucca Mountain rail access corridor and rail alignment in Nevada. Likewise the DOE should be compelled to imme-

diately conduct a national level transportation specific NEPA document. This seems to be a necessary, sufficient, logical and warranted step given the consequences of attacks and the need for states input on such transportation decisions. As the end point of a national transportation program, the proposed Nevada rail corridor is critical in the overall performance of the Yucca planning, so articulation of that plan prior to consideration of the rail spur makes policy sense. The safety and security challenges that arise from building an extensive rail spur into the Yucca facility demand a robust dialogue on the issues, one that NEPA requires and to date DOE seems unwilling to offer any realistic approaches to studying.

7. *WEIB "Straw man" Shipment Routes.* Nevada has recommended that DOE select routes for the national transportation system using a reasonable transportation methodology developed by stakeholders. Transportation safety and security require that DOE first plan what routes will be used so that meaningful stakeholder input can be focused on the planning. The DOE should follow a three-step process proposed by the Western Interstate Energy Board (WIEB):

a. DOE would designate "straw man" routes, preferably in a national level transportation NEPA document.

b. Member states would individually and collectively evaluate the DOE routes, and then designate preferred routes on a regional basis.

c. DOE would then formally adopt the routes selected by WIEB, and designate these routes (allowing exceptions for use of designated alternative routes in emergency situations) in DOE contracts with rail and highway carriers.

8. *Start the Section 180(c) process.* Nevada has recommended that DOE implement the transportation planning and emergency response training program, required under Section 180 (c) of the NWPAA, through formal rulemaking. Absent rulemaking, the State of Nevada believes that congressional action might be needed to implement the program, as was the case with the Waste Isolation Pilot Plant (WIPP) DOE-State cooperative transportation planning program. The connection to safety and security is especially important here, without systems of well funded emergency response training the transportation program is seriously flawed. One of the critical safety and security issues states would be facing is this program becoming an unfunded Federal mandate that requires them to provide 50 years of training, protection and response capabilities for the Yucca program. In terms of transportation program oversight, response capabilities and organizational capacity, the proposed Yucca program would entail three or perhaps four generations of emergence response professionals, human capital and their institutional memory, being imbued with relevant experience and knowledge of the program's operational parameters.

9. *Respect State, Local, and Tribal Regulation.* Nevada has recommended that DOE support state regulatory enhancements to manage transportation risks and address public perceptions of transportation risks. These would include, but not be limited to:

a. Port-of-entry inspections and state escorts for DOE shipments at DOE expense.

b. States, in conjunction with local governments, may also impose seasonal, day-of-week, and time-of-day restrictions on DOE to address unique local conditions.

c. Tribal governments may also regulate DOE shipments.

10. *Address issues associated with Terrorism and Sabotage.* Nevada has recommended that DOE address acts of sabotage and terrorism against repository shipments. DOE has acknowledged, in the Final EIS for Yucca Mountain, the potential vulnerability of shipments to such attacks. Analyses by Nevada contractors have concluded that the releases and consequences could be many times greater than reported by the DOE, resulting in catastrophic cleanup and recovery costs. NRC has likewise neglected its mandate as a regulatory body with respect to this issue. Specifically:

a. DOE needs to systematically address terrorism issues and risks in development of repository transportation operational protocols.

b. NRC has yet to respond to the specific terrorism risks and impacts documented in Nevada's 1999 petition for rulemaking (Docket PRM 73–10).

Since today's hearing is directly related to the last issue of concern, the next section of this presentation will offer a methodology that could be used by the DOE, if it proceeds with the Yucca project, to assess and mitigate the risks of human initiated events like terrorism, sabotage, large scale protests and similar risk inducing events.

Human-Initiated Events and Systematic Risk Assessment

Given stakeholder concerns and the threat of terrorism, this testimony recommends the development of a comprehensive human initiated event threat assessment process for the proposed Yucca Mountain transportation system.[9] This process could be used by DOE to assess repository transportation impacts as part of its NEPA requirements, and in responding to the Western Governors Association (WGA) resolution on terrorism and sabotage.

The following discussion identifies ways to improve current risk assessment techniques to meet the challenges of human initiated events, including terrorism, sabotage, induced or deliberate accidents, and violent protests. The recommended threat assessment process is presented as a series of industry standard methods and concludes with exemplar scenarios. The testimony is based only on open source data to develop these ideas, concepts and methodologies.[10]

Shipment Vulnerability Debate

For three decades, risk analysts have debated the vulnerability of spent nuclear fuel shipments to acts of terrorism and sabotage. The details of the debates are documented in studies prepared for the State of Nevada in 1998 and 2005.[11] The sabotage related attack scenarios evaluated in NRC and DOE analyses have changed little over the decades. The DOE/NRC analyses assume that a single spent fuel shipping cask is attacked at one location, by one group of attackers, using one weapon. The basic analyses assume that the attack breaches the cask and releases a small fraction of the contents. In general the agency sponsored analyses differ in estimates of the amount of radioactive material released, the details of the release and dispersal, the area contaminated, the population exposed, the resulting human casualties and the economic impacts.

The first NRC regulations requiring physical protection of spent fuel shipments were issued in response to a 1977 draft assessment by Sandia National Laboratories (SNL). That assessment, and a follow-up study by SNL in 1980, indicated that sabotage of a shipment in an urban area could cause hundreds to thousands of casualties, and billions of dollars in economic losses and cleanup costs.[12] The NRC issued interim physical protection requirements for spent fuel shipments in 1979, and adopted the current system of regulations (10CFR73.37) by rulemaking in 1980.

Subsequent studies sponsored by NRC and DOE sharply reduced the estimated causalities and economic losses from this original scientific work product. The debate over the consequences of a successful terrorist attack resumed in 1984, when the NRC, acting on the new sponsored studies, issued a proposed rule eliminating physical protection requirements for most spent fuel shipments. The NRC had concluded that the expected consequences of a successful attack in "a heavily populated area such as New York City would be no early fatalities and less than one (0.4) latent cancer fatality." This NRC proposed rule was opposed by state governments, environmental groups and some nuclear industry sources. Three years later, the NRC terminated the proposed rule, without explanation. Throughout the 1990s, however, the NRC continued to downplay attack consequences. At the same time, public discussion of vulnerability and consequences temporarily subsided.

The controversy re-emerged nationally in 1995 as the DOE began the NEPA scoping process for the proposed Yucca Mountain geologic repository. State governments and other parties urged DOE to more directly address terrorism and sabotage in the Yucca Mountain environmental impact statement (EIS). In its role as a stakeholder, the state of Nevada filed detailed scoping comments on the impacts of terrorism against repository shipments during 1995, and published several supporting studies between 1996 and 1998. Based on these studies, Nevada's Attorney General filed a petition for rulemaking with the NRC in June 1999. The Nevada petition documented the vulnerability of shipping casks, and argued that shipments to a national repository would create greater opportunities for terrorist attacks and sabotage. The petition, which requested strengthening of the current regulations and a comprehensive reexamination of radiological sabotage, was endorsed by the Western Governor's Association (WGA). *More than 8 years later, the NRC has still not officially responded to the Nevada petition.*

DOE acknowledged that shipping casks are vulnerable to terrorist attack in the 1999 Draft EIS for Yucca Mountain.[13] In support of the Draft EIS, DOE sponsored a 1999 SNL study of cask sabotage, which demonstrated that high-energy devices

(HEDs) were "capable of penetrating a cask's shield wall, leading to the dispersal of contaminants to the environment." The SNL study also concluded that a successful attack on a truck cask could release more radioactive materials than an attack on a rail cask, even though rail casks would contain, on average, up to six times more SNF than truck casks.[14]

In the 2002 Final EIS for Yucca Mountain, DOE updated its sabotage analysis, assuming more highly radioactive SNF, a larger respirable release, and a higher future average population density for U.S. cities.[15] In this document the DOE estimated that a successful attack on a truck cask in an urbanized area under average weather conditions would result in a population dose of 96,000 person-rem and 48 latent cancer fatalities. For a successful attack on a large rail cask, DOE estimated a population dose of 17,000 person-rem and 9 latent cancer fatalities. In neither case did DOE evaluate any environmental impacts other than health effects, and ignored the social-economic impacts of a successful act of sabotage. While the DOE did not specifically estimate cleanup costs after such an attack, the FEIS states that clean-up costs following a worst-case transportation accident could reach $10 billion.

Analyses prepared for the state of Nevada by Radioactive Waste Management Associates (RWMA) calculated that sabotage impacts could be considerably greater.[16] RWMA replicated the DOE Final EIS sabotage consequence analyses, using the RISKIND model for health effects and the RADTRAN model for economic impacts, the SNL study average and maximum inventory release fractions, a range of credible values for the gap inventory of Cs–137 and considered a range of population densities and weather conditions.

RWMA concluded that an attack on a truck cask using the same common military demolition device assumed in the DOE analysis could cause 300 to 1,820 latent cancer fatalities, assuming 90 percent penetration of the cask by a single blast. For the same device used against a large rail cask, RWMA estimated 46 to 253 latent cancer fatalities, again assuming 90 percent penetration. The major radiological health impacts of an attack would be caused by the downwind dispersion of respirable material (mainly particles with a diameter less than 10 microns) that could be ejected from the damaged cask. Depending upon the meteorological conditions present at the time of an attack, the respirable aerosol of radioactive materials could affect an area of 10 square kilometers (3.9 square miles) or more. RWMA estimated cleanup costs ranging upward from $668 million for the rail incident, and $6.1 billion for the truck incident, to more than $10 billion. Full perforation of the truck cask, likely to occur in an attack involving a state-of-the art anti-tank weapon, could cause as many as 3,000 to 18,000 latent cancer fatalities, and cleanup and recovery costs could far exceed $10 billion.

In October 2007, DOE published the Draft Supplemental Environmental Impact Statement for Yucca Mountain (DSEIS) and the Draft Rail Alignment Environmental Impact Statement (RA DEIS).[17] Both the DSEIS and the RA DEIS address the impacts of sabotage against repository shipments. In both volumes DOE states that it has "analyzed plausible threat scenarios, required enhanced security measures to protect against these threats, and developed emergency planning requirements that would mitigate potential consequences for certain scenarios. *DOE would continue to modify its approach to ensuring safe and secure shipments of spent nuclear fuel and high-level radioactive waste, as appropriate, between now and the time of shipments.* For the reasons stated above, DOE believes that under general credible threat conditions the probability of a sabotage event that would result in a major radiological release would be low" (DSEIS, p. 6–22; RA DEIS, p. 4–314, *emphasis added*).

Acknowledging "the uncertainty inherent in the assessment of the likelihood of a sabotage event," the DSEIS and RA DEIS evaluated events in which "a modern weapon (high energy density device)" is used to "penetrate a spent nuclear fuel cask." DOE evaluated the consequences of events occurring in representative urban, suburban, and rural areas. Based on new research by Luna (2006)[18] and on European studies, the DSEIS assumed that the single weapon attack studied would result in a smaller release of respirable material than DOE assumed in the 2002 FEIS. For a sabotage event against a truck cask in an urban area, the DSEIS reports consequences about half what DOE estimated in the 2002 FEIS—a population dose of 47,000 person-rem, and 28 latent cancer fatalities. For an attack on a large rail cask in an urban area, the DSEIS reports consequences about double what DOE estimated in the 2002 FEIS—a population dose of 32,000 person-rem, and 19 latent cancer fatalities.

The DSEIS does acknowledge the aforementioned State of Nevada analyses under the heading "Transportation Sabotage: An Opposing Viewpoint." Despite this note in the document, and as in earlier DOE analyses, the DSEIS does not provide specific information on:

- The land area contaminated.
- Economic losses due to disruption of normal activities.
- The cost of cleanup.

As of 2008, the State of Nevada is preparing its own detailed reassessment of transportation sabotage impacts. To date, Nevada has submitted comments on the DSEIS sabotage consequence analyses (January 10, 2008). In those comments, Nevada emphasized that the DSEIS continues to ignore the consequences of a terrorist attack using one or more weapons that completely perforate the shipping cask, or a combination of weapons specifically designed to breach, damage, and disperse the cask contents. Such an attack could result in impacts more severe than those evaluated by DOE.

The new DOE-sponsored research does not address such impacts. In fact, the Venturi effect created by full perforation of a shipping cask would likely negate the reduction in impacts claimed in the Luna (2006) study. In its key conclusion, DOE asserts that the factors identified by the State of Nevada "could affect the chances of success but not the outcome of the sabotage event." [19] DOE presents no evidence in the DSEIS, the RA DEIS, or any of the cited references to support that assertion.

Moreover, the DSEIS ignores evidence, including terrorism studies funded by DOE, that this agency's activities may be particularly attractive symbolic targets for sabotage or terrorist attacks. The DSEIS also ignores past instances in which human errors in cask fabrication and cask loading actually occurred during NRC-licensed shipments, and created conditions that could have compromised cask performance in the event of a sabotage event. Likewise, the DSEIS ignores Nevada's argument that unique local conditions such as proximity of the existing mainline railroads to urban location like downtown Las Vegas and Reno-Sparks must be factored into consequence assessments, resulting in potential multi-billion dollar cleanup costs and business disruption impacts.

In summary, all of the consequence assessments so far conducted by NRC, DOE and the State of Nevada assumed single-phase attack scenarios. None of these consequence assessments have evaluated the effects of an attack involving the simple impact-exacerbating tactics identified by the U.S. Army peer review report more than two decades ago: namely the combined use of a breaching device and a dispersal device, or use of multiple breaching devices. None of these consequence assessments have incorporated insights obtained from the 1998 testing sponsored by International Fuel Containers, Incorporated, at the U.S. Army Aberdeen Test Center in which a newer generation weapon, a TOW II warhead, was used. Most significantly, none of these consequence assessments have evaluated any of the impact-exacerbating tactics studied by counter-terrorism experts in the post-9/11 threat environment. Credible hijack and control scenarios, specialized truck bomb scenarios, and/or concealed weapons like IED's (improvised roadside devices), coupled with insider assistance, diversionary attacks, and/or suicide tactics, could potentially result in radiological consequences far greater than those previously estimated by NRC, DOE or the State of Nevada.[20]

WGA Resolution

The primary motivation for this suggest analytical format, prior to publication of the DOE's DSEIS, was the WGA resolution regarding Yucca Mountain transportation. The WGA represents nineteen Western states and three territories. The association allows state political leaders to address critical policy issues in a wide variety of areas. The WGA organization thus helps state leaders develop strategies to address complex issues facing western states.[21] WGA has been actively involved in nuclear waste transportation planning for two decades. In 2007, WGA renewed and revised a policy resolution (07–2) on the risks of terrorism and sabotage against repository shipments.[22] The original resolution behind this new document had been adopted in 1998.

WGA Resolution 07–2 notes that in the aftermath of the September 11, 2001 terrorist attacks, *the altered threat environment calls for new, more comprehensive terrorism assessment tools.* The resolution calls upon the NRC to "fully address the consequences of attacks against all components of the nuclear waste handling and transport system, to include: attacks against transportation infrastructure, the theft of a shipment, use of high-energy explosives against a shipment cask, and direct attacks against a shipment cask using antitank missiles or other armament that could cause a loss of containment." WGA further requests that NRC "strengthen its efforts to share information with state and local governments regarding spent fuel shipment vulnerabilities and consequences, " recognizing that "sharing of information must be conducted within the framework of preventing the release of sensitive or classified information to individuals without a need to know."

The WGA resolution notes that DOE has acknowledged the vulnerability of shipments in the 2002 Final EIS for Yucca Mountain. The resolution states: "DOE should continue to address acts of sabotage and terrorism in its NEPA documents, and should incorporate terrorism/sabotage risk management and countermeasures in all DOE transportation plans, protocols, and practices relating to operation of a repository, interim storage facility, and/or intermodal transfer facility, including liability for costs and damages resulting from terrorism/sabotage against nuclear waste shipments. DOE should share security-related information with state and local governments to the maximum extent practicable." [23]

Comprehensive Threat Assessment

Driven by regulations and the need to protect the public from catastrophic events, the nuclear industry has a continuous quality improvement process for security against human-initiated events. The two recently issued DOE NEPA documents, the Draft Supplemental EIS and the Draft Rail Alignment EIS, employ only some of the methods used by the industry to protect fixed assets like reactors, but the not expressly documented analytical method employed by DOE for the Yucca Mountain transportation effort *does not use state-of-the-art assessment techniques, nor does the assessment effort meet industry standards for fixed site security.*

The problem with the DOE's approach to the NEPA documents (SEIS's) is twofold: How to assess the threat of human-initiated events against spent fuel shipments to Yucca Mountain nationally, and second, for the proposed Caliente rail line in Nevada. Once again, human initiated events refer to the range of malevolent acts that could be perpetrated on the shipments—including such events as terrorism, sabotage, deliberate accidents and violent protest movements.[24] Shipments refer to the various means that will be used to move SNF and HLRW into the national transportation system/proposed Caliente rail corridor from their current storage facilities at commercial nuclear power plants, DOE weapons production sites, and from other DOE serviced/regulated/owned source facilities.

This presentation recommends specific and detailed methodologies that are used in social science and industry that, that taken together, could constitute a comprehensive threat assessment for the proposed Yucca Mountain transportation system:

- The identification of relevant human-initiated events by use of Meta analysis.
- Development of a systematic multi-level assessment of human-initiated event risks for the transportation modes, facilities, corridors, etc.
- A resultant matrix of human initiated events and attack scenario exemplars suitable for DOE study and consideration in NEPA documentation.

Human-initiated Events

Several large categories of human-initiated events can be identified across the major components of the transportation system and relative to the known or expected characteristics of the Yucca Mountain transportation system. These include terrorism, sabotage, accidents and protests.[25] The table below lists these four event categories and notes how they may apply to the four major transportation components derived from the DOE "Transportation Concept of Operations" and DOE "Draft National Transportation Plan".[26]

Figure 1: Human Initiated Event and transportation Activity Matrix

Threat Categories	Origination Point	Transport Activities	Transfer Facilities	Destination Facilities
Terrorism Attacks	X	X	X	X
Sabotage	X	X	X	X
Deliberate Accidents	X	X	X	X
Violent Protests	—	X	X	—

Terrorism attacks are defined here as those malevolent actions that are designed to cause significant symbolic events, a significant incident that acts as a statement in opposition to the shipments or an act that directly attacks the transports, casks, facilities for handling shipment casks or the personnel that are involved in the four categories of transportation infrastructure noted above. These terrorism acts will range on a continuum from symbolic events that are not intended to result in a release of radioactive materials all the way up to sophisticated full-scale assaults de-

signed to release/disperse the casks radioactive contents. These attacks may be motivated by a political/social/religious agenda, attacks prompted by an anti-Federal government agenda, attacks based on the deliberate creation of economic dislocations in the energy sector, or attacks that are inspired by a social issue. These attacks may be perpetrated by foreign nationals, American citizens, or any combination of the two.

Sabotage is defined herein as those malevolent activities that could interfere with the safe and secure loading/unloading and transportation of the nuclear wastes. Examples may include the use of insider information, employee tampering with casks, large scale labor problems, and/or deliberate contamination of casks/transports to delay shipments. Sabotage can also be defined as activities detrimental to the safe and secure transport of these materials. Sabotage acts will also exist on a continuum from attacks not intended to damage a cask up to an act designed to release/disperse the inventory of radionuclides. The motives for such attacks are considered to be the same as for the terrorist attacks and acts of sabotage may be perpetrated by the same range of adversaries.

Deliberate Accidents are defined here as those malevolent human-initiated events that result in endangerment of the shipments, their casks, or the overall shipment campaign. These may come from deliberate acts by an individual or small group interfering with shipment operations and from negligent acts of those within the transportation system that can create a potential, minimal or significant release of the highly radioactive contents. Like terrorism and sabotage, these acts will also exist on a continuum from attacks not intended to damage a cask up to an act designed to release the inventory of radionuclides. The motives are considered to be the same as for the terrorist attacks and they may be perpetrated by the range of adversaries.

Violent Protests are defined as those potentially malevolent activities that could interfere with the safe and secure transportation of the nuclear wastes. These protests may also be used as a rouse to hide the intentions of malicious actors who seek to commit acts of terrorism or sabotage by hiding their actions in the larger protest group. This category is included to recognize the fact that these shipments will face significant opposition from protesters, based on the experiences of other shipment campaigns around the world. Such large scale protests may endanger the shipments and/or public health by delaying shipments and increasing routine doses to the population. These acts will also exist on a continuum from collective acts not intended to damage a cask up to an act designed to release the inventory of radionuclides. The motives for such attacks are considered to be the same as for the terrorist attacks and they may be perpetrated by the same range of adversaries.

Threat Assessment Process

A range of threat assessment procedures should be conducted prior to commencement of shipments and continued during the shipping campaign, in a way that measures risk over time, and enables assessments to be continually updated.[27] The longitudinal risks may also need to be assessed because of a rise in energy related terrorism acts,[28] and as part of the on-going DOE obligation to operate under procedures equivalent to the NRC physical protection regulations (10CFR73.37), although DOE is not necessarily subject to these particular NRC regulations.

Meta-threat analysis

The analysis-in-depth suggested herein starts with consideration of a wide range of potential threats and consequences vis-à-vis shipments. Such a systematic assessment would first involve an exhaustive meta-analysis of the literature relative to attacks on shipments of hazardous materials, including SNF and HLRW. This process would need to account for emerging threats and tactics being employed by terrorists/adversaries around the globe. It would also include IAEA (2007) guidance documents on the subject and documentation of threats that have arisen in the global theater where terrorists/adversaries operate. This data should then be vetted with outside stakeholders, not just internal DOE security personnel, to define the various challenges that the Yucca Mountain transportation effort could face over the five decade life span of the proposed project. Emerging from this effort would be a pro-active catalogue of transportation risks and issues that should inform a NEPA analysis, not just cherry-picked scenarios that react to the latest criticisms, from Nevada studies, government analysis and/or those generated by the National Academy of Sciences.[29]

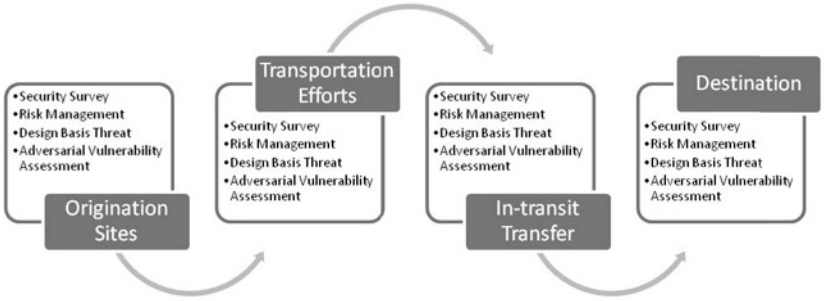
Vulnerability Assessment Process

Transportation security for a cargo as dangerous as the highly radioactive SNF and HLW should prompt planners to use the best available techniques to reduce threats from human-initiated events. Typically security professionals use four levels

of vulnerability assessment techniques to protect nuclear facilities and other critical industrial applications.[30] Each of several techniques has strengths and weaknesses but with the combined (triangulated) use of all of these techniques, taken together as a NEPA inspired research strategy, allows for improvements in security and better defines risks. That is, the use of more than one of these offers a more robust methodological approach to the task at hand, all of them allows for a form of defense-in-depth, a common principle in nuclear security.

These four techniques offer a comprehensive risk identification and mitigation potential for security (and safety) issues relative to the proposed Yucca Mountain transportation program. In order to use these techniques it is first useful to identify where they may apply to the overall transportation effort. The following chart helps situate these four techniques relative to the four major components of the transportation infrastructure.

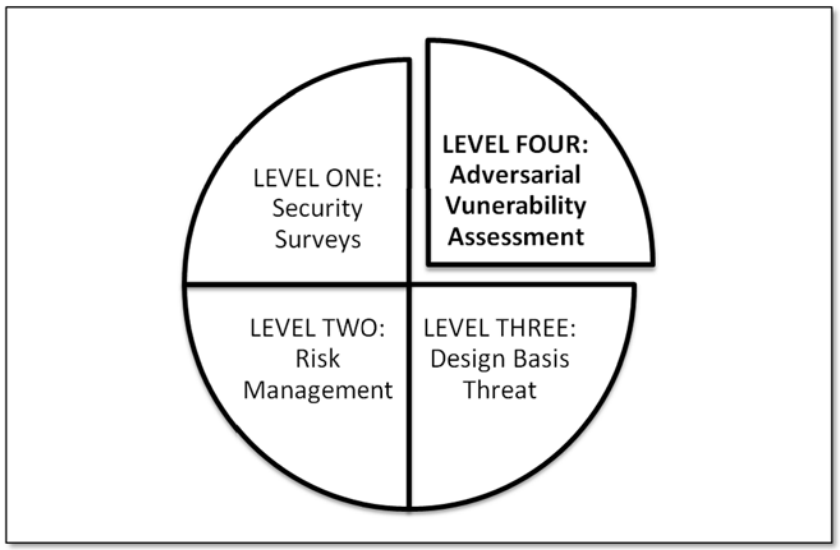
Figure 2: Transportation analysis-in-depth: Risk reduction strategy



The examination of how these four identification, reduction and mitigation techniques can be used in the systematic assessment of risk for the Yucca Mountain project, the analysis-in-depth risk reduction concept noted above, will require some details on what each technique will entail in real world practice.

First, it is critical that they should be considered an integrated system of analysis, albeit one with some level of analytical hierarchy. The following chart demonstrates their interrelationship and the preferred hierarchy.

Figure 3: Analysis-In-Depth Concept; Sub-Components



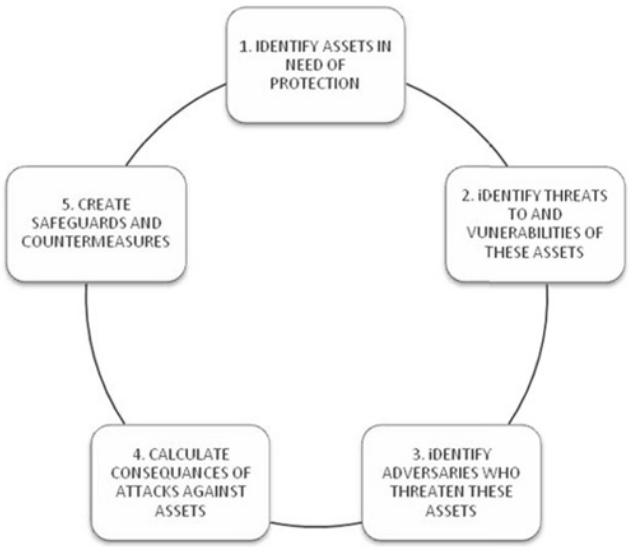
Security Surveys. Security surveys are the first level in this overall transportation risk assessment schema. These surveys represent a physical examination of the transportation security arrangements and typically use a check list approach to the examination of risks. This allows for the standardization and management of the assessment process.[31] These checklists aid security efforts and provides for a consistent, albeit unimaginative examination of risks.[32] This form of security management is typical for any number of industrial applications and has a long tradition in security. At a minimum this survey technique needs to be performed at various levels of the proposed Yucca Mountain transportation effort (for example at origination sites, for transportation efforts, at in-transit transfer facilities, and for destination conveyance infrastructures).

The problem with this technique is that it is typically not focused on the adversaries and does not necessarily encourage thought relative to new countermeasures as risks change over time. In fact surveys become reified and represent a binary (good/bad, black/white) approach to security and risk mitigation. They seem to imply that risks will somehow emerge from the world and show themselves during such surveys. Checklists are also fixed lists of observations to be conducted and typically closed to emerging risks that have heretofore not been known or overlooked. The list becomes what human assets are fixated on, not focusing security personnel on the creative protection of the cargoes, rather making them focus on paperwork. These surveys are often misused, especially when they come to represent ways to manage people and ensure compliance to a security regime or regulations.[33]

Security surveys have a place in the overall transportation efforts but they are not in and of themselves a cure for the risks that transportation efforts to Yucca Mountain will face. They represent a tool that should be employed by those involved in the transportation effort and at all levels of the transportation infrastructure. They are the first line of defense since they are carried out traditionally by line staff and management. They also require periodic updates, monitoring and analysis as to their ability to meet current challenges and contemporary threats. They represent the first line of a transportation specific defense-in-depth concept yet to be adopted by DOE.

Risk Management. The second step in the analysis-in-depth risk assessment process is to use well understood and common place risk management techniques. The process of risk management is fairly straightforward. In the first phase of the risk management process the analyst begins with identification of the assets in need of protection and ends with the identification of safeguards and countermeasures.[34] Thus, the organization using the risk management technique should basically follow the flow of the following interrelated items:

Figure 4: Risk Management Process



After this largely abstract intellectual task is completed, the organization then uses an expert opinion process to rank order priorities and probabilities are assigned to each sub-phase noted above. Typically this involves predominantly quantitative outcomes and these outcomes are summarized in tables, charts, and the like. Thereafter the transportation management team would appropriate, and field, security resources accordingly. As implied by the chart, the process begins anew once this final task is completed and in practice should become a never ending series of assessments designed to improve the overall robustness of security.

Risk management is not without critics in the nuclear field and elsewhere. Some argue that the traditional ways of conducting risk management need to be more quantitative or address more aspects than are traditionally used in such analysis,[35] while others note the political nature of the use of risk management.[36] A systematic examination of risk management also reveals some issues of concern.[37] Once again this technique is typically binary and closed to outside input. For example, there is rarely outside input on contemporary threats and vulnerabilities since risk management rests on known (historic) security issues. This means that risk management is reactive, not proactive in mitigating risks. This also usually means that risk management is done without the creative spirit that the terrorists/adversaries bring to the table. If it is initiated, managed and used by organization staff in agencies (for example the NRC and DOE) and represents the collective consensus of these sometimes limited perspectives.

Risk assessment is rarely the creative expression of alternatives. Risk management is management of risks by managers and for managers. It is not done from alternative perspectives (for example the adversaries). The assignment of probabilities in risk management is often based on fantasy-like numbers that are created out of thin air to placate internal constituencies and/or to serve political purposes. Once these probabilities are codified in tables, charts and the like, they become real in their consequences as everyone involves start to believe they are real and act accordingly.[38] The process itself and especially the documents that emerge create overconfidence in the numbers, a false sense of security that is problematic in the face of real world creativity from adversaries.

Risk management has its place in transportation planning for the potential Yucca Mountain program and the problems noted here do not negate its usefulness. As a technique it is not a be all and end all in risk assessment. The use of quantitative data helps policymakers believe in a program, but that is a two edged sword.

Design Basis Threat (DBT). The third level of the analysis-in-depth paradigm is the DBT. In some respects the DBT is a technique not that unrelated to risk management.[39] A DBT is a proxy threat, a hypothetical scenario based on descriptions of the threats found at the time of its articulation.[40] The DBT sets the standards for security personnel by defining the training, weapons and tactics that a terrorist/adversary group could use to attack nuclear facilities. The best practices of DBT usage call on its proponents to design security to face the contemporary threats, recognizing vulnerabilities and to allocate resources accordingly.[41] DBTs tend to focus on infrastructure and physical security hardware, more so than risk management.[42]

The published DBT details for nuclear power plants serve as an illustration of this process and its outcomes. The DBT has been used since the 1970s in the United States and is not a single process. It has also been used in various ways by different countries as the IAEA seeks to standardize the process around the globe. First and foremost it is the basis of physical protection systems (PPS) for *fixed* sites. It also serves as the means by which an evaluation of that PPS is conducted. Since 2000 the IAEA has promoted the DBT and provides (in conjunction with Sandia National Labs) nine steps for the process of development, use and maintenance of a DBT system. Besides the basic facts noted in this paragraph certain scholars [43] suggest that a DBT generally includes:

- Identification of the roles and responsibilities within and connected to the organization.
- Development of operating assumptions for the usage of the DBT.
- Identify a range of potential generic adversary threats.
- Identify a list of threat characteristics.
- Identify sources of threat information.
- Analyze and organize threat-related information. (Steps one to six create a threat assessment document).
- Develop threat assessment and gain consensus about said.
- Create a national level DBT.
- Introduce the DBT into the regulatory framework.

The DBT process, and specifically its first six steps, should yield both motivations for attacks, intentions of the attackers and characteristics of the attacking force. These are then matrixed across a range of adversaries (protesters, activists, extremists, criminals and terrorists). In most cases these are created from assumptions based on historic data and firmly rooted in a philosophy that insists that all threats must be "credible." This philosophy is counter intuitive to 9/11 threat realities and may blind the creators to new/emerging threats or threats that are evolving as past threats change to meet new circumstances. Typically the DBT philosophy does promote the continuation of the status quo.

The NRC and DOE have updated their DBT in the aftermath of the 9/11 attacks, once in 2003 and again in 2004, both times in a process outside the normative framework for such adjustments. Specific details are not known for these classified documents but the expectation is that they will take years to implement a new DBT and that the final product was diluted as a result of industry concern over costs. Likewise, the DBT has been criticized since it does not meet the threat threshold the 9/11 attacks presented.[44]

DBTs have their critics and the criticisms run along similar lines to those for the risk management techniques.[45] The DBT is a typically binary process and closed to outside input, primarily for security reasons like classification of results. Because of the closing of discussion for security reasons, there is rarely outside input on contemporary threats and vulnerabilities. Second, like risk management the DBT becomes a reactive device. As a proxy attack strategy it is not proactive in mitigating risks. Similar to risk management the DBT process is dominated by the organization staff. The DBT represents the collective consensus of these limited and sometimes self-serving perspectives. It does not represent a creative expression of alternatives and rarely addresses emerging threats. Once the DBT is determined it becomes real in its consequences for the agencies using this technique. The threat is what the DBT says it is, nothing more or nothing less. The DBT provides insider organizations, although not the public and other stakeholders, with a sense of confidence that may be disproportional to the risks and reality of a changing world. It allows an existing organization like the DOE to define what the threats are, and once the DBT is constructed, to maintain a faith in their assessments, a self fulfilling belief system that can be dangerous when one is protecting something as potentially dangerous as highly radioactive wastes.

In some cases critics have argued for a layered approach to DBT implementation, a strategy that recognizes financial resource differentials in government's responsible for implementation.[46] This criticism is primarily focused on less developed nations where the resources necessary to protect nuclear assets are not readily available. In the case of advanced industrial nations the AHARA—as high as reasonably achievable—principle behind such debate suggests that these nations should achieve the IAEA's goals of securing radioactive materials against human-initiated events. These less than reasonable security debates do not apply to the United States, a country rich in resources.

Additionally, as noted DBTs are supportive of the status quo. They seem to say to everyone involved we are doing good, look how hard we worked to define the threats and our perceptions of the vulnerabilities we face are excellent. It ignores alternative threats since they are deemed too improbable or they are not perceived at all—they are deemed a very subjective "uncreditable." The DBT seems to communicate to one and all that whatever terrorists/adversaries can do poses a lesser threat than our proxy measure (DBT), a dangerous oversimplification in the post-9/11 world of nuclear security.

DBTs also take time to change, they are not assessed systematically but rather on an as needed basis. The DOE mandated and NRC inspired changes in implementation for weapons production facilities and commercial nuclear power plants after the 9/11 terrorist attacks illustrate this delay—changes in the DBT were revised in 2003, changed again in 2004 and are still undergoing implementation as of the seventh anniversary of those attacks with an expected date for completion being in 2008.[47] Supporters argue that a change in the DBT is costly but critics point out so too would be a successful attack.

The DBT is a step forward from past risk assessment practice and one that allows transportation managers to create a proxy for security to train against. It is different than security surveys and risk management, but it is not the single magic bullet to security. Rather the DBT is one tool in the overall toolbox for risk mitigation. The fourth technique, adversarial vulnerability assessment, helps with some of the limitations noted for DBTs.

Adversarial Vulnerability Assessments (AVA). One critical omission of all three of the techniques detailed above is bringing the motives, mindset and creativity of the adversary into the risk equation. Those who would wish to perpetrate a human-ini-

tiated event are far more resourceful than the security surveys, risk management and DBT techniques seemingly give them credit for. To accomplish the task of recognizing such creativity Johnson (2005)[48] advises that it is necessary to conduct a "mental coordinate transformation." This means that when assessing risks for critical SNF and HLW transportation infrastructure it is necessary to think like the perpetrators, not like security professionals, not like energy company officials, and not like oversight agency management.

The major barrier faced by security professionals and risk managers in doing this task is that they are rarely prepared for this mental transformation. As a result of organizational socialization they cannot, or will not, use the opportunity to actively look for threats, to engage in the alternative and/or to think like the terrorist, saboteur or other perpetrator of human initiated events. They have difficulty letting the opponent define reality, a reality that is securely planted in their professional lives by the very industry they seek to protect—one that for many reasons does not admit gleefully to risks, threats or terrorism as a potentiality. Altering Johnson's (2005)[49] approach for the proposed Yucca Mountain transportation project would entail the necessary mental transformation for the NEPA assessment. This is best accomplished by the following steps:

- Understand the full scope of the transportation effort. This includes all aspects, parts, components and variables in the transportation system. This is difficult since the totality of the system is enormous and in many cases individuals are asked to transform their thinking while working on small parts of the overall picture. Still it is necessary since the parts are integrated and the risk synergy for the total system far outweighs the singular transportation component risk level.
- Brainstorm in a creative, innovative, and multi-level manner that allows you to not just identify a threat, but to focus attention to a range of threats.[50] Once the totality of the program is recognized, members of a risk focus group are gathered to work on the issues, share their insight into the risks, and to brainstorm on threats facing this transportation system. These discussions would reveal attack exemplar scenarios tied to risks, not singular as is the case of a DBT, but multiple threats and with multiple consequence profiles.
- Once attack sceneries are identified, the group starts to edit these down to essential elements and exemplars that demonstrate vulnerabilities of the system, not just a single part of this complex transportation effort. This group would prioritize potential attacks which represent a range of possibilities, consequences and potential responses. These alternatives must be developed, articulated and vetted with a wide range of constitutes/stakeholders to gain additional insight and to reduce the problems of group think and collective risk blindness that sometimes arise in small groups.
- The last step is to determine the feasibility of these attacks by means of a range of attack articulations, analyze radiological consequences of these alternatives and devise countermeasures to mitigate these risks.

Several provisos are offered to those considering adopting AVA methods. First and foremost, let those involved be creative.[51] In the case of terrorism threats, the changes in technology, availability of information and tactical knowledge of adversaries demand that those involved be allowed freedom to achieve this creative approach to risk assessment. Historical data, and historically situated risk perceptions, are less significant in the face of global social challenges like currently are transpiring, a point often missed by those who work in formal organizations. AVA risk measurement is predicated on creativity which must be combined with organizational experience, technological skills and bureaucratic imagination. All of these tasks are difficult for many formal organizations to engage in but the challenges they pose are important to overcome.

Johnson (2005)[52] advises that creativity is the domain of individuals, not formal organizations. Good group dynamics can enhance this individual creative spirit and groups need to be involved to prioritize and determine feasibility. One of many techniques to help this creative process is to reverse engineer the attacks in an effort to solve problems that have yet to arise. This is a particularly cogent piece of advice given the elongated timeline for the proposed Yucca Mountain project and points out the need for a systematic longitudinal analysis paradigm so that data can be gather to inform the processes.

One of the most interesting advisements offered is that the system conducting this analysis must bring in outsiders and not use the typical cast of insider characters who have vested interests in the status quo. The use of the same old energy industry insiders and the same supporting industrial infrastructure insiders ensures the

same old results. It does not offer a creative analysis of threats. Furthermore it is necessary to combine these outsiders with *creative* insiders in the brainstorming groups and set ground rules for all the contributors. These ground rules have to allow for all manner of input and treats each contribution as significant, be it from inside or outside the typical organizational patterns of thought. Johnson (2005)[53] offers some AVA imperatives as guidance. These have been modified to the Yucca Mountain project and include:

- Minimize the conflicts of interest and reduce wishful thinking on the parts of group members.
- To promote creativity in the group processes, the system must not punish those who creatively deconstruct its assumptions, bias, and working relationships.
- The overall group and its work product need to be assessed by a second group of outsiders, called assessors. These assessors should be independent from the Yucca Mountain project, experienced in finding problems and offering solutions, and in no small measure represent the public stakeholders for the project.
- All parties involved must discard the binary way of viewing risks. This means individuals need to be able to work within the gray areas of life, not the rigid confines of an engineering perspective or other professional paradigm that promotes the status quo philosophy.
- The group members are tasked with finding vulnerabilities and risks, which is their primary purpose. As such they should not be encouraged to find no vulnerabilities or no risks, a philosophy that is counter-productive to the AVA process.
- AVAs are not a pass or fail technique for the group as a whole and the group participants must be encouraged to reject this form of thinking. The point is to find vulnerabilities and risks, not fix them per se. Thus, finding these vulnerabilities and risks is a good outcome, not a negative outcome of the group process.
- The process must be done before transportation planning is fixed in policy, done again when plans are finalized but before transport begins, and done periodically thereafter (for example bi-annually or annually).
- AVAs are a holistic approach to vulnerability identification and risk mitigation. They should not be done in isolation (for example for the rail system alone).
- The conveners, participants and/or the assessors should not be restricted as to time, budget or attack possibilities. They should be allowed to creatively face the social context of global conditions relative to terrorism, sabotage and other human initiated events.
- The group should be encouraged to never underestimate the resourcefulness, creativity or commitment of the adversary. They should remember it is the adversary that defines the threat, not the protectors.
- The group should establish a hierarchy of threats, simplest to most complex, least severe radiological consequences to most severe radiological consequences. They need also look at contingencies that would take a second tier threat and make it a major radiological event. This is one area where DBTs seem to fail, they are based on one threat and do not necessarily account for such upgrades and modifications.
- Everyone should assume that adversaries know what security arrangements are in place, have the creativity to overcome these and/or will exploit those instances where the system does not meet its presumed minimum operation levels. Systems fail and human security systems fail to protect even the most critical of assets over time.
- A range of attacks should be considered by this group: terrorism, sabotage, probes of the security system, insider/outsider/insided-outsided threats, social engineering, and the many other varieties of human initiated events that could transpire.
- The longer a system is in place, the higher its vulnerability and risk to attack. Vigilance decreases with familiarity, hence the systematic reevaluation of risks becomes increasingly important over the lifespan of the program. It is equally important to note that once an AVA is complete, perhaps even deemed excellent by all involved, it is not the end product and cannot stand alone in the face of the ever-changing security threats faced. Once the AVA is complete it is then systematically and periodically subject to challenges from the original group, from new group participants and from new human initiated events/tactics.

- The group should avoid common nuclear industry fallacies. For example, many believe that all vulnerability will be discovered and thus all risk mitigated. Likewise they should be cautioned to avoid mindsets that see compliance as good security, layers of mediocre security equals good security, and/or that high-tech security is the answer for all vulnerabilities and risks.

AVAs are not the final and best answer to the reduction of risk, just as security surveys, risk management and DBTs do not tell the whole risk story. They are also not unknown to the nuclear industry. For example, they have already been used in the nuclear waste field for low level waste and relative to interim storage.[54] They also were advocated as one means to increase security after the terrorist attacks of September 11, 2001, and for use in critical infrastructure sectors like the chemical industry.[55] These techniques have even been around a sufficient length of time to note development in their applications.[56] Regarding their use in environmental policy debates, as has been the case with Yucca Mountain, Busenberg (1999)[57] notes they are effective in reducing policy disputes, a quality lacking in many suggestions for the proposed Yucca Mountain project. Last, these have been used in the energy industry for security considerations relative to oil and gas pipelines, a similar security dilemma to that posed by transporting nuclear waste across country to Nevada.[58]

The AVA is one tool in the overall risk assessment tool set necessary to secure the transportation of highly radioactive materials like SNF and HLW. Used in conjunction with the other three techniques it allows a different perspective on the problems the system may face, a valuable perspective not offered at any other time in the lifecycle of the transportation program.

Step Three—Scenario Exemplars

Analysis-in-depth is a management paradigm and an analytical imperative necessary to accomplish the formable task of vulnerability and risk assessment for the complex, decades-long transportation effort that would be necessary for the proposed Yucca Mountain repository. The following sections provide a risk matrix and corresponding threat scenarios that could emerge from an AVA process, if applied. The details and threats noted therein are gleamed from the literature and used to represent best practices in risk assessment for the proposed Yucca Mountain project. They do not directly correspond to the issues noted above; rather they examine a subset of the overall risk of human-initiated events for transporting nuclear wastes. The following matrix shows some of the potential human-initiated events identified for further study.

Figure 5: Potential Human Initiated Events for Further Study

Potential Events	Origination Sites	Transport Issues	In-transit Transfer	Destination Facilities
Labor disruptions with deliberate tampering of transports and/or casks. (SAB)	X	X	X	X
Deliberate contamination of transports and/or casks. (SAB)	X		X	
Disabling of shipment safeguards. (SAB)	X	X	X	
Actions meant to delay the shipment process and creating significant media attention. (PRO)		X	X	
Actions meant to delay transport and create increased routine radiological impacts. (PRO)		X	X	
Actions meant to create a dislocation of transport, cask or transportation infrastructure. (PRO)		X	X	

Potential Events	Origination Sites	Transport Issues	In-transit Transfer	Destination Facilities
Use of geographically disadvantageous features along the transportation routes to impact shipments. (ACC)		X	X	
Exploitation of steep grades, tunnels, and bridges to create accident conditions potentially challenging cask integrity. (ACC)		X	X	
Inducement of inadvertent collisions involving toxic, explosive or flammable chemicals. (ACC)	X	X	X	X
Use of man-portable missiles to penetrate the cask and disperse the contents into the environment. (TER)	X	X	X	X
Use of military weapons/tactics to penetrate the cask and disperse the contents into the environment. (TER)	X	X	X	X
Use of adjacent transportation infrastructure and cargos to augment an attack and increase consequences.		X	X	
Capture of the cargo.		X	X	

Abbreviations: SAB = sabotage, PRO = protests, ACC= accident, TER = terrorism

The Risk Matrix

Considering the Yucca Mountain transportation options identified by DOE, five modes of transportation could potentially be used for repository shipments over the projected 50-year operations period. These include:

- Rail Casks Shipped by Rail.
- Rail Casks Shipped by Barge.
- Rail Casks Shipped by Heavy Haul Truck.
- Truck Casks Shipped by Rail.
- Truck Casks Shipped by Legal Limit Truck.

These five transportation modes, traveling to Yucca Mountain from 76 shipping sites in more than 30 states, with an average shipment distance greater than 2,000 miles, will be subject to many possible attack strategies over five decades. This approach uses a range of exemplar human-initiated event strategies as an illustration of the risks associated with the transportation of these materials. These include:

- Theft of the Cargo.
- Transportation Infrastructure Attacks.
- Anti-tank and/or Stand-off Weapons Attacks.
- Capture of Shipment and use of High-Energy Density (HED) Weapons.

These exemplars suggest that a range of consequences must be factored into risk assessment since they present a range of potential attack outcomes. These outcomes include:

- Attacks to Disrupt Shipments (Minimum Radioactive Dispersal).
- Attacks to Disperse the Cask Contents (Moderate Radioactive Release).
- Attacks for Maximum Consequences (Catastrophic Radioactive Release).

The following chart allows for the analysis of these various factors simultaneously and has estimates of the consequences listed in italics as they relate to the scenario analysis that follows.

Figure 6: Risk Matrix

Yucca Mtn. Risk Matrix	Rail Casks Shipped by Rail	Rail Casks Shipped by Barge	Rail Casks Shipped by Heavy Haul Truck	Truck Casks Shipped by Rail	Truck Casks Shipped by Legal Limit Truck
Theft of the Cargo.	*Disrupt* Disperse Max. Cons.	*Disrupt* Disperse Max. Cons.	*Disrupt* Disperse Max. Cons.	*Disrupt* Disperse Max. Cons.	*Disrupt* Disperse Max. Cons.
Transportation Infrastructure Attacks.	Disrupt *Disperse* Max. Cons.	*Disrupt* Disperse Max. Cons.	Disrupt *Disperse* Max. Cons.	Disrupt *Disperse* Max. Cons.	Disrupt *Disperse* Max. Cons.
Anti-tank and/or Stand-off Weapons Attacks.	Disrupt Disperse *Max. Cons.*	Disrupt Disperse *Max. Cons.*	Disrupt Disperse *Max. Cons.*	Disrupt Disperse *Max. Cons.*	Disrupt *Disperse* Max. Cons.
Capture of Shipment.	Disrupt Disperse *Max. Cons.*	Disrupt Disperse *Max. Cons.*	Disrupt Disperse *Max. Cons.*	Disrupt Disperse *Max. Cons.*	Disrupt Disperse *Max. Cons.*

Taken together these modes, human initiated event strategies, and hypothesized consequence outcomes can be conglomerated into a risk matrix for simplified use by risk managers, security personnel and for the specific purposes of risk identification, analysis and mitigation. A radioactive dispersal, whether it is considered minimum, moderate or catastrophic for the purposes of analysis, depends on many variables, including the age of the fuel, the burn-up history of that fuel, the crud inventory in the transport cask, the degradation of the cladding, the number of assemblies in a given cask, and so forth. However, a properly constructed assessment process can address these variables, and recommend appropriate countermeasures and mitigation strategies.

Conclusion

First and foremost, the materials in question, huge quantities of highly radioactive wastes from nuclear power plants and weapons production facilities, *do not have to be transported* across America to Yucca Mountain. The energy industry has assured the public that power plants are safe and secure, thus *sheltering the wastes in place* at these facilities seems the prudent thing to do. At these secure facilities they would not be subject to protests, labor unrest, sabotage or terrorism during transit activities, in short they are safer where they sit.

Likewise, if the program does move forward, alternatives to DOE management exist. As the NAS has suggested, DOE could be replaced as the agency of responsibility for the proposed Yucca Mountain project. This action would help the creditability of the proposal since many stakeholders and members of the general public have historic reasons to distrust this agency and its claims regarding safety and security. This is another option for you to consider in your oversight role.

If the program does proceed and DOE is left in charge, the testimony examined the current state of risk assessment for human-initiated events against SNF and HLW shipments to the proposed repository at Yucca Mountain, Nevada. In the process this analysis identified a variety of potential human initiated event scenarios for consideration by this agency and its transportation planners. These represent a range of creditable threats, consequences and for a variety of transportation components that would be used during a transportation campaign.

The necessity of this reconsideration is based on the fact that attack scenarios evaluated in the Draft Supplemental EIS for Yucca Mountain, and the Draft Nevada Rail Alignment EIS, repeat the methods used by DOE and NRC over the past three decades. They are not proactive in response to 9/11 and do not reflect state-of-the-art risk assessment techniques. The DOE/NRC analyses assumed single-phase attack scenarios and other limiting assumptions that may artificially constrain the results. None of these consequence assessments have evaluated impact-exacerbating tactics, such as combined use of a breaching device and a dispersal device, or use of multiple breaching devices. None of these consequence assessments have evaluated the impact-exacerbating tactics studied by counter-terrorism experts in the post-9/11 environment.

The methodology presented herein advocates use of an analysis-in-depth method that uses current risk assessment methods, but adds the well known AVA as an extra layer of protection to offset the change in the risk environment due to terrorism. The purpose of the AVA technique is to harness the creatively and ingenuity of people outside the formal bureaucratic organization that is the DOE and in doing

so improve the risk analysis. Such an approach would respond to the WGA resolution on transportation terrorism risks.

Ways to Review DOE Efforts

In the post-9/11 world almost all Federal agencies with a significant homeland security role have had to rethink their assumptions on how best to serve the public interest. One conclusion suggested from the alternative scholarship on Yucca Mountain transportation risks is that the DOE does not get it—they are stuck in an engineering based bureaucratic paradigm, or if you will, an organizationally dysfunctional way of thinking. This DOE mindset prevents this agency from looking outside of their narrowly defined transportation risk assessment agendas.

In the case of Yucca Mountain, the unwritten "demand" for programmatic progression after years of DOE mismanagement seemingly overrides a systematic and serious reconsideration of risks for the transportation of these radioactive materials. This committee should consider how to compel reform of the DOE's work on Yucca Mountain in light of the new threat environment. To date a systematic recognition of this new threat environment is not evidenced by this agencies continued refusal to acknowledge real and pressing issues with their planning for shipments to Yucca Mountain.

The DOE is continually revising their transportation concept for Yucca Mountain and could readily alter their current program to adopt the recommended risk reduction process. Considering the currently delayed schedule for the repository and the proposed rail line, it seems unlikely that shipments to Yucca Mountain could begin earlier than 2020. There is ample time for another agency or if left in charge, for the DOE, to systematically address human-initiated events. Revision of such documents as the various Supplemental EIS's, Transportation Concept of Operations, National Transportation Plan, national routing studies, and in its implementation of Section 180c technical and financial assistance to affected states and Indian tribes would at a minimum be desirable.

If this testimony could leave this committee with only three points to consider, they would be:

Point One:

- Yucca Mountain transportation is risky and will present a target rich environment for adversaries. The shipments are symbolically important and represent a radiological significant target.
- The solution is to shelter the shipments in place at the sites of waste origin. As noted by the NRC, energy industry and others, they are safe and secure faculties. Why expose wastes to risks during transportation if not necessary?

Point Two:

- DOE has systematically neglected to address the laundry lists of concerns brought forth by stakeholders. These deliberate choices by the DOE increase the likelihood of attacks, the consequences of those attacks and the resultant social dislocations if these attacks succeed.
- The solution is to compel the DOE its mandate to engage in a meaningful national level NEPA process for transport. That process should directly addresses stakeholder concerns that have been documented over the decades of Yucca Mountain debates.

Point Three:

- DOE, in consultation with stakeholders, should engage in systematic risk assessment method of analysis. In particular, it should use the AVA process in conjunction with other methods to provide a more robust triangulated analysis.
- The solution here is to do it and will allow the DOE to avoid the potentially fatal fault of being reactive to threats and become more proactive in relationship to human initiated events.

I wish to thank the Committee for allowing me to offer an alternative perspective on this important issue. If you have any questions I will be happy to answer them.

Endnotes

[1] My training at the University of Nevada, Las Vegas was in political sociology, deviance, and criminology.

[2] This educational center is funded by the Office of the Director of National Intelligence (ODNI) as part of a grant to seven CSU's in the southern California area. The CSUN IC–CEA assists students who are considering careers in the intelligence field.

[3] The term "human initiated event" comes from Ballard, J.D. (2002). "Asymmetrical Sabotage Tactics: Nuclear Facilities/Materials and Vulnerability Analysis." Publication available at *www.numat.at.*

[4] In particular past projects have included Robert J. Halstead, Fred Dilger, Hank Collins and Marvin Resnikoff. The testimony herein reflects the authors interactions with, and the decades of work, these colleagues have contributed to the debates over Yucca Mountain. Likewise, research teams for the referenced NATO project herein as well as NUMAT conference work should be recognized.

[5] See "Testimony" before the U.S. Senate, Committee on Energy and Natural Resources, One-Hundredth Seventh Congress regarding S. J. Res. 34 Approving the Site at Yucca Mountain, Nevada, for the Development of a Repository for the Disposal of High-level Radioactive Waste and Spent Nuclear Fuel, Pursuant to the Nuclear Waste Policy Act of 1982. May 2002. Available at *http://www.yuccamountain.org/leg/ballard052202.html*. See also "Testimony of James David Ballard." U.S. House of Representatives, Subcommittee on Highways and the House Subcommittee on Transportation and Infrastructure. April 2002. Available at *http://gopher .house.gov/transportation/highway/04–25–02/ballard.html.*

[6] Nevada and other scholars have for many years discussed this idea in a variety of forums and forms. This section briefly summarizes that body of literature. For more complete details see: Nuclear Regulatory Commission Documentation for Petition." Agency petition for Rulemaking pursuant to 5 U.S.C. § 553 and 10 C.F.R. § 2.800–2.804. *Federal Register.* September 1999 and Halstead, R.J., F. Dilger and J.D. Ballard. (2005) "Planning for an Unpredictable Event: Response to Terrorist Attack against SNF Shipment." *Waste Management* conference proceedings. See also "Testimony" before the U.S. Senate, Committee on Energy and Natural Resources, One-Hundredth Seventh Congress regarding S.J. Res. 34 Approving the Site at Yucca Mountain, Nevada, for the Development of a Repository for the Disposal of High-level Radioactive Waste and Spent Nuclear Fuel, Pursuant to the Nuclear Waste Policy Act of 1982. May 2002. Available at *http://www.yuccamountain.org/leg/ballard052202.html* and "Testimony of James David Ballard." U.S. House of Representatives, Subcommittee on Highways and the House Subcommittee on Transportation and Infrastructure. April 2002. Available at *http://gopher.house.gov/transportation/highway/04–25–02/ballard.html* for more specifics on symbolic attacks, target rich environments and associated issues.

[7] See Ballard, J.D. (2002). "Shelter-In-Place: The Logic of High-Level Nuclear Waste Security." Agency paper. State of Nevada's Agency for Nuclear Projects: Carson City, NV. This agency paper was based on a presentation at Stanford University, January 2002.

[8] See Halstead, R.J., F. Dilger, J.D. Ballard and H. Collins (2008). "State of Nevada Perspective on the U.S. Department of Energy Yucca Mountain Transportation Program." Paper #8154. Waste Management Conference 2008 proceedings. Publisher: Waste Management, Phoenix, AZ.

[9] Ballard, J.D., R.J. Halstead, F. Dilger, H. Collins and M. Resnikoff. (2008). "Assessing the Vulnerability of Yucca Mountain Shipments: A Threat Matrix for Human-Initiated Events." Paper #8152. Waste Management 2008 Conference proceedings. Publisher: Waste Management, Phoenix, AZ.

[10] The use of open source documents as the basis of this presentation and as the means to develop this methodology should demonstrate to the Committee the level of publicly available materials that potential adversaries can access. Specific attack details and details on tactics have deliberately been left out of this presentation in consideration of safety and security.

[11] See Halstead, R.J. and J.D. Ballard. (1997). "Nuclear Waste Transportation Security and Safety Issues: The Risk of Terrorism and Sabotage against Repository Shipments." Prepared for the state of Nevada, Agency for Nuclear Projects (October 1997; Revised, December 1998). This report can no longer be accessed on the web due to security concerns, but can be requested in writing from Mr. Joseph Strolin, Administrator, Agency for Nuclear Projects, Suite 118, 1761 E. College Parkway, Carson City, NV 89706. Also refer to J.D. Ballard, R.J. Halstead, F. Dilger, H. Collins, "Planning for an Unpredictable Event: Vulnerability and Consequence Reassessment of Attacks on Spent Fuel Shipments," revised version of a paper presented at Waste Management 2005. The revised paper was not included in the proceedings, but it is available on line at *http://www.state.nv.us/nucwaste/trans.htm*. Last, see North Atlantic Treaty Organization (NATO). Project # SST.CLG.978964, "Terrorism Attacks on Nuclear Power Plants and Nuclear Materials Transports." This large research group was led by Dr. Friedrich Steinhausler, Institute for International Security, Stanford University. October 2001 to July 2004. A final report was submitted to NATO but to date has note been released.

[12] The NRC and DOE continue to use the singular terminology of "sabotage" to designate any incident related to human initiated events. The use of the term human initiated events herein was originally coined to help move forward the discussions of risks to a more encompassing discussion in the post-9/11 threat environment.

[13] DOE. (1999). "Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada," DOE/EIS–0250D, U.S. Department of Energy, Washington, DC (July 1999).

[14] Luna, R. *et al.,* (1999). "Projected Source Terms for Potential Sabotage Events Related to Spent Fuel Shipments," SAND99–0963.

[15] DOE. (2002). "Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada," DOE/EIS–0250. Available on the web at *http://www.ymp/gov/documents/feis__a/ index.htm.*

[16] Lamb, M. *et al.,* (2002). "Potential Consequences of a Successful Sabotage Attack on a Spent Fuel Shipping Container: An Analysis of the Yucca Mountain EIS Treatment of Sabotage." Prepared by Radioactive Waste Management Associates for the State of Nevada, Agency for Nuclear Projects.

[17] Respectively: DOE. (2007). "Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste

at Yucca Mountain, Nye County, Nevada" DOE/EIS–0250F–S1D and DOE, "Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada—Nevada Rail Transportation Corridor," DOE/EIS–0250F–S2D and "Draft Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada," DOE/EIS–0369D.

[18] Luna, R, (2006). "Release Fractions from Multi-Element Spent Fuel Casks Resulting from HEDD Attack," Waste Management 2006 conference. Publisher: Waste Management, Phoenix, AZ.

[19] DOE. (2007). See page 6–21 from "Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada" DOE/EIS–0250F–S1D and DOE.

[20] See Ballard, J.D., R.J. Halstead, F. Dilger, H. Collins. (2007). "Yucca Mountain Transportation Security Issues: Overview and Update." Waste Management 2007 conference. Publisher: Waste Management, Phoenix.

[21] WGA. "Making the West the Best: Western Governors' Association 2007 Annual Report". Available online at: *http://www.westgov.org/wga/publicat/annrpt07.pdf.*

[22] WGA. "Western Governors Association Policy Resolution 07–02: Assessing the Risks of Terrorism and Sabotage against High-Level Nuclear Waste Shipments to a Geologic Repository or Interim Storage Facility."

[23] WGA. "Western Governors Association Policy Resolution 07–02: Assessing the Risks of Terrorism and Sabotage against High-Level Nuclear Waste Shipments to a Geologic Repository or Interim Storage Facility."

[24] Ballard, J.D. (2002). "Asymmetrical Sabotage Tactics: Nuclear Facilities/Materials and Vulnerability Analysis." Publication available at *www.numat.at.*

[25] See Ballard, J.D., R.J. Halstead, F. Dilger, H. Collins. (2007). "Yucca Mountain Transportation Security Issues: Overview and Update." Waste Management 2007 conference. Publisher: Waste Management, Phoenix. Also Ballard, J. D. (2002). "Asymmetrical Sabotage Tactics: Nuclear Facilities/Materials and Vulnerability Analysis." Publication available at *www.numat.at.*

[26] DOE. (2006). "Transportation System Concept of Operations," DOE/RW–0584 and DOE. (2007). "National Transportation Plan," pre-decisional draft dated July 16, 2007.

[27] Ballard, J.D. (2002). "Asymmetrical Sabotage Tactics: Nuclear Facilities/Materials and Vulnerability Analysis." Publication available at www.numat.at.

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Senator ENSIGN. Thank you, Dr. Ballard.

Mr. Hamberger?

STATEMENT OF EDWARD R. HAMBERGER, PRESIDENT AND CEO, ASSOCIATION OF AMERICAN RAILROADS

Mr. HAMBERGER. Mr. Chairman, Senator Thune, the Association of American Railroads appreciates the opportunity present our views on the transportation of spent nuclear fuels.

Before I address that topic, however, on behalf of the members of the AAR, I want to express deep condolences to the victims, the families, and friends of those who were hurt and injured in too many cases, fatally injured in the commuter rail accident in Chatsworth, California last Friday.

We have been working very closely with this Committee, the corresponding Committee in the House, to help craft legislation to address certain areas of rail safety. We are very pleased that that has reached its final step, and I believe even as we meet here today, it may be being considered on the House floor. And I hope that it will pass the Senate before the end of the week because we believe that it will result in meaningful rail safety improvement.

The freight industry, rail industry does have an excellent safety record, in general, in moving hazardous materials, including spent nuclear fuel in particular. Since my written testimony and my several appearances before this committee over the past year go into great detail on our safety record, I will only note here today that 2007 was the safest year on record in terms of accident rate per million train miles.

We recognize that special measures are needed to ensure that the spent fuel is moved without incident. The railroads believe that the safest possible method of transporting spent nuclear fuel is in dedicated trains. We are pleased to note that the Department of Energy now shares that belief and wish that the Department of the Navy would soon join us both in that belief.

We believe that dedicated trains offer important safety advantages.

One, they do not require switching in rail yards as do trains in general freight service, thus reducing time in transit and potential for mishandling accidents.

Two, dedicated trains allow the train to be equipped with electronically controlled pneumatic brakes and premium suspensions.

Three, spent nuclear fuel cars are extremely heavy, heavier than any other car in service, thus increasing the potential for an accident because of the different handling characteristics.

And finally, spent nuclear fuel dedicated trains can be moved with greater security. Escorts as required by DOT and the Nuclear Regulatory Commission would have certainly a less difficult time monitoring spent nuclear fuel on dedicated trains than in general freight service.

We are confident that we can transport spent nuclear fuel extremely safely. However, despite all the precautions taken, there is clearly some risk in the transport of spent nuclear fuel. No firm in any industry and certainly not a rail industry that has an outdoor factory floor of some 140,000 miles in length can guarantee with complete certainty that no accident or terrorist attack will occur. Recognizing this, Congress enacted the Price-Anderson Act which provides limited protection for companies from an incident involving the release of nuclear material, including its transport.

More than 25 years ago, the Interstate Commerce Commission ruled that railroads have a common carrier obligation to transport shipments of spent nuclear fuel. Partially that ruling came because of the liability protections offered under Price-Anderson.

Freight railroads, alone of all modes, also have a common carrier obligation to transport toxic by inhalation hazardous and other highly hazardous materials. Chairman Inouye referred to that earlier. Chlorine is certainly one of those and anhydrous ammonia the other. Those two represent about 80,000 car loads a year of 100,000 car loads of TIH materials. However, we do not have any comparable Price-Anderson protections for this transportation, nor can railroads fully insure against the multi-billion risks associated with these shipments. This places the railroads in an untenable position.

I submit that if there is a public interest need for railroads to be compelled to carry TIH chemicals, just as the ICC determined there is for spent nuclear fuel, there is a corresponding public interest for limiting the railroad's potentially ruinous liability as in the case with Price-Anderson. This could be achieved if policymakers enacted a Price-Anderson type solution for TIH shipments, and we would be pleased to discuss this with members of the Committee.

We thank you for the opportunity to testify, and I, of course, would be pleased to answer any questions you may have.

[The prepared statement of Mr. Hamberger follows:]

PREPARED STATEMENT OF EDWARD R. HAMBERGER, PRESIDENT AND CEO, ASSOCIATION OF AMERICAN RAILROADS

The Association of American Railroads (AAR) appreciates this opportunity to address the transportation of spent nuclear fuel (SNF). AAR members account for the vast majority of freight railroad mileage, employees, and traffic in Canada, Mexico, and the United States.

Should meaningful amounts of spent nuclear fuel require transportation, it is likely that AAR members would be called upon to handle most of those movements (whether it would be to the Yucca Mountain repository[1] or elsewhere), since the Department of Energy (DOE) has indicated that it prefers rail transportation for the

[1] The AAR takes no position on whether Yucca Mountain is an appropriate site for a repository.

movement of SNF.[2] Why? Safety, predominantly. There has never been a release of radioactive materials in connection with the transportation of SNF by rail.

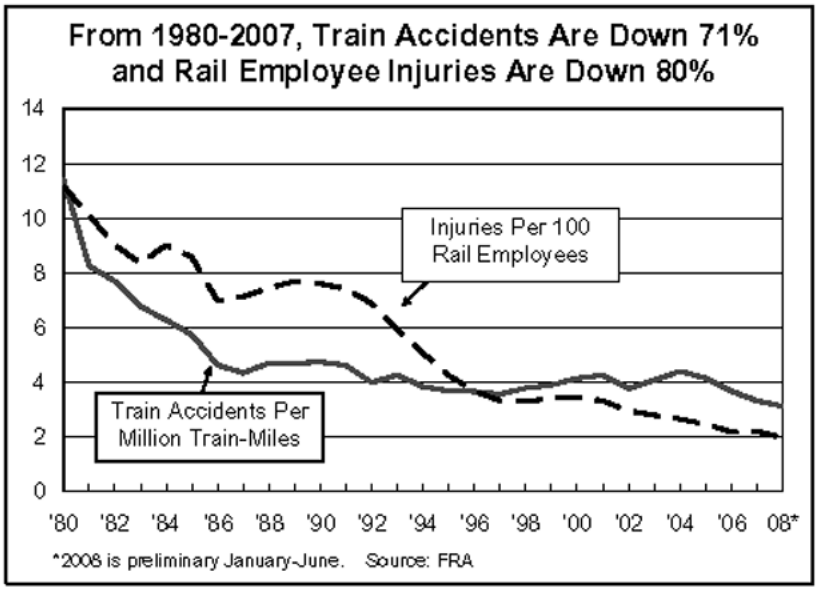
Overview of Freight Rail Safety

First of all, on behalf of the members of the AAR, I offer my deep condolences to the victims of the recent tragic commuter rail accident in California and their families. As many of you know, freight railroads have been working very closely with this Committee and others in Congress to draft and pass comprehensive legislation that will address critical areas of rail safety. We are confident that the legislation will result in meaningful rail safety improvement.

For freight railroads, pursuing safe operations is not an option, it is an imperative. It makes business sense and it's the right thing to do. Through massive investments in safety-enhancing infrastructure, equipment, and technology; extensive employee training; cooperation with rail labor, suppliers, customers, communities, and the Federal Railroad Administration (FRA); cutting-edge research and development; and steadfast commitment to applicable laws and regulations, freight railroads are at the forefront of advancing safety.

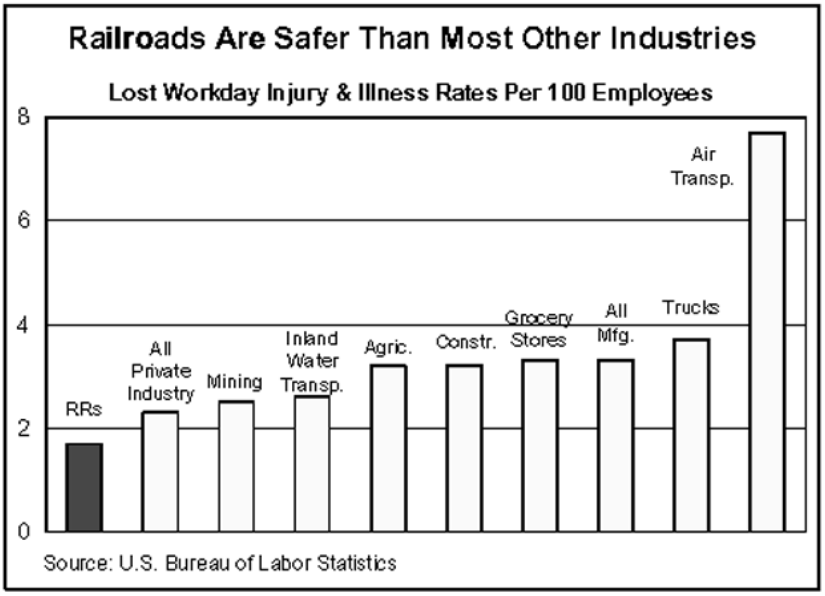
Freight railroads have an excellent and improving safety record, reflecting the extraor-dinary importance railroads place on the safety of their employees, their customers, and the communities they serve. As an official from the FRA noted in testimony to Congress in February 2007, "The railroads have an outstanding record in moving all goods safely."

In fact, 2007 was the safest year ever for railroads, according to FRA data, and preliminary partial year data for 2008 show continued improvement. In 2007, the train accident rate was the lowest ever, down 71 percent since 1980. The grade crossing collision rate was the lowest ever, down 77 percent since 1980. And the employee injury rate was the second lowest ever, down 80 percent since 1980.



Moreover, according to U.S. Department of Labor data, railroads today have lower employee injury rates than other modes of transportation and most other major industry groups, including agriculture, construction, manufacturing, and private industry as a whole—even grocery stores. Available data also indicate that U.S. railroads have employee injury rates well below those of most major foreign railroads.

[2] See U.S. Department of Energy, Office of Civilian Radioactive Waste Management, *A Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* J–1, February 2002.



Railroads are proud of their safety record, which results from their recognition of their responsibilities regarding safety and the enormous resources they devote to its advancement. At the same time, railroads want rail safety to continue to improve. Railroads are always willing to work cooperatively with Members of this Committee, other policymakers, the FRA, rail employees, and others to find practical, effective ways to make this happen.

Railroads Have an Excellent Hazmat Safety Record

Today, U.S. railroads transport very little spent nuclear fuel. In 2007, there were just 14 originations; in the 5-years from 2003 to 2007, there were only 314. Railroads do, however, haul significant amounts of other hazardous materials. In fact, each year, 1.7 to 1.8 million carloads of hazardous materials are transported by rail in the United States. Materials that present a "toxic inhalation hazard" (TIH)—*i.e.,* gases or liquids (such as chlorine and anhydrous ammonia) that are especially hazardous if released—are a subset of hazardous materials. Railroads transport around 100,000 carloads of TIH each year. For perspective, DOE projects that there would be, at most, around 400 carloads of spent nuclear fuel transported annually.

In 2006 (the most recent year for which data are available), 99.996 percent of rail hazmat shipments reached their destination without a release caused by a train accident. That equates to one accident with a hazmat release for every 56,000 rail hazmat carloads.

The overall rail hazmat accident rate is down 88 percent since 1980 and down 39 percent since 1990. And although no firm in any industry can guarantee that it will never suffer an accident, the railroads' overall safety record should give you and the public confidence in the rail transport of SNF if the public interest requires its transportation.

How Can the Safety of SNF Transport be Maximized?

Notwithstanding freight railroads' excellent safety record, they recognize that public concern over radioactive materials requires that all parties involved in the transport of SNF take special measures to ensure safe movement. In particular, the DOE and Department of Defense (as the shippers of SNF), the Department of Transportation (the regulator of the safety aspects of hazmat transport), and the railroads must work together to design the safest possible transportation system for SNF.

For many years, the rail industry has urged the use of dedicated trains—*i.e.,* trains with no other freight than SNF, traveling from one origin to one destination—to transport SNF. In 2005, the DOE issued a statement that it was DOE pol-

icy to use dedicated trains as the usual mode for its shipments to Yucca Mountain.[3] The DOE identified important safety, security, and system cost benefits to the use of dedicated trains at that time. More recently, the DOE stated, in its application to the Surface Transportation Board (STB) to construct a railroad line that would serve the Yucca Mountain repository, that it intends to use dedicated trains on that line.

Dedicated trains in fact offer numerous key safety advantages that would reduce the already very small possibility of an accident involving SNF transport.

First, SNF cars in dedicated trains would not have to be "switched" in and out of trains at rail yards, many of which are located in or near major metropolitan areas. Switching would be required if SNF cars were transported in general freight service. Switching increases the amount of handling a freight car receives. All else equal, the more a freight car has to be handled, the greater the risk of an accident.

Second, the weight of SNF cars could increase the potential for an accident if the cars were hauled in general freight service. The vast majority of loaded rail cars on the U.S. freight rail network weigh no more than 286,000 pounds.[4] SNF cars, though, would weigh approximately 400,000 pounds. If hauled in general freight service, these extremely heavy SNF cars could generate high in-train forces, such as slack action (the force exerted throughout the train as trains accelerate, decelerate, and operate over undulating and curved terrain) that could lead to a derailment. Slack action is much easier to control in a short, dedicated train than in a long, general service train, especially in trains with extremely heavy cars mixed with other normal-weight cars.

Third, premium suspensions can be incorporated in all rail cars in dedicated trains. Premium suspensions are higher-quality freight car wheel assemblies. They reduce lateral wheel forces and vertical dynamic impact forces, which can result in derailments. If SNF were transported in general freight service, there would be no way of guaranteeing that the cars transporting other freight would have premium suspensions. More generally, dedicated trains eliminate the possibility of a derailment of an unrelated car having as a side effect the derailment of or damage to a car carrying SNF.

Fourth, dedicated trains are essential if the newest technology designed to lower the possibility of a derailment is to be used for SNF shipments. The AAR's Performance Specification for Trains Used to Carry High Level Radioactive Material, also known as S–2043, calls for additional safety requirements and technologies, including on-board defect detection systems, premium suspensions, and electronically-controlled pneumatic (ECP) brakes. ECP brakes function only when all cars in a train are equipped with them. In addition to providing superior braking performance, ECP brakes utilize a communication system throughout a train that can be used to transmit train health information to the locomotive crew and security personnel. The train health information, obtained from the on-board defect detection systems, would include monitoring for known derailment causes such as excessive truck hunting;[5] rocking;[6] wheel flats;[7] ride quality; defective bearings; vertical, lateral and longitudinal acceleration; and, of course, braking performance.

Fifth, dedicated trains minimize the time spent in transportation, an important factor for security and efficiency.[8] It would take longer (possibly significantly longer) to transport SNF from origin to destination if SNF were transported in mixed-freight trains instead of dedicated trains, because the switching of rail cars in and out of trains takes time and because railroads can more readily schedule dedicated trains to move quickly and smoothly through sensitive areas.

Finally, dedicated SNF trains can be transported with greater security. Escorts, which are required by the Nuclear Regulatory Commission (NRC) for all SNF move-

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[3] *Department of Energy Policy Statement for Use of Dedicated Trains for Waste Shipments to Yucca Mountain,* ilable at *p://www.state.nv.us/nucwaste/news2005/pdf/doe050718rail.pdf.*

[4] A small minority of rail cars in general service weigh up to 315,000 pounds. In extremely rare cases (for example, movements of power plant generators), railroads will haul much heavier shipments.

[5] Truck hunting is an instability at high speed of a wheel set (the "truck" in railcar terminology) causing it to weave down the track, usually with the flange of the wheel striking the rail.

[6] Excessive lateral rocking of cars and locomotives can occur, usually at low speeds. The speed range at which this phenomenon occurs is determined by such factors as the wheel base, height of the center of gravity of each individual car or locomotive, and the spring dampening associated with each vehicle's suspension system.

[7] A wheel flat is a flat spot or loss of roundness of the tread of a railroad wheel.

[8] U.S. Department of Transportation, *Identification of Factors for Selecting Modes and Routes for Shipping High-Level Radioactive Waste and Spent Nuclear Fuel,* p. vi (April 1998).

ments, will be able to monitor SNF much more easily in dedicated trains than in general freight service.

The FRA has also determined that dedicated trains for the transportation of SNF would reduce accident risks through avoidance of yards, reduced derailment potential, and reduced risk of the involvement of other hazardous materials in an accident.[9] Similarly, the National Academy of Sciences has determined that dedicated train transportation of SNF has operational, safety, security, communications, and planning advantages over transportation in general merchandise trains.[10]

DOE is planning to build the transportation equipment for the transportation of SNF to Yucca Mountain in conformance with S–2043. In addition, the U.S. Navy, which currently ships more SNF than any other entity, is currently designing and building a new freight car to meet S–2043. The prototype car is currently being tested at the Transportation Technology Center, Inc., an AAR-operated rail research and test facility in Pueblo, Colorado.

The rail industry commends the DOE for recognizing the benefits of dedicated trains, and commends the U.S. Navy for agreeing to conform with S–2043. However, despite its 2005 policy statement in favor of the use of dedicated trains generally and its statement to the STB that it will use dedicated trains on its own Yucca Mountain line, DOE has not committed to use dedicated trains for SNF shipments on other rail lines, including shipments to Yucca Mountain.[11] The U.S. Navy has not yet agreed to use dedicated trains for SNF shipments. Railroads respectfully suggest that policymakers should strongly encourage the DOE and Navy to do so.

SNF Liability Protections Offer a Model for TIH Transport

Railroads are confident that they could transport SNF extremely safely, and they are working hard every day to further enhance the safety of their operations.[12] However, as indicated above, no firm in any industry—and certainly not a rail industry that has an outdoor "factory floor" that is more than 140,000 miles long—can guarantee, with complete certainty, that no accident or terrorist attack will occur.

Despite all the precautions that might be taken, there is clearly some risk involved in the use and handling of nuclear fuel. Recognizing this, in 1957 Congress enacted the Price-Anderson Act. The Price-Anderson Act limits the liability of a company (including railroads) from an incident involving the release of nuclear material (including in transportation). The Act provides for a fund, to which all nuclear power plant licensees contribute when an incident occurs, to cover any damages in excess of required insurance levels.

More than 25 years ago, the Interstate Commerce Commission (ICC), the predecessor of today's Surface Transportation Board, held that the railroads' common carrier obligation requires them to transport shipments of SNF, whether the railroads want to handle such shipments or not. The ICC's decision at that time was based, in part, upon the liability protections that the Price-Anderson Act afforded to the railroads.

I would be remiss if I did not note that, likewise, because of their common carrier obligation, freight railroads—alone among all modes of transportation—must also transport TIH and other highly-hazardous materials in response to a reasonable request. However, the railroads do not have any comparable Price-Anderson Act protections for this transportation.

While TIH materials are a small percentage of total rail traffic—they constitute only about 0.3 percent of all rail carloads—the transportation of such materials exposes railroads to significantly higher costs and potentially ruinous liability due to the extraordinarily dangerous characteristics of the commodities themselves. Indeed, an accident involving TIH could cause casualties orders of magnitude higher than the casualties that would likely result from an accident involving SNF. Accidents

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[9] *Use of Dedicated Trains for Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel* (March 2005), available at *www.fra.dot.gov/downloads/safety/report_dedicated_trains.pdf.*

[10] Committee on Transportation of Radioactive Waste, National Research Council of the National Academy of Sciences, *Going the Distance: The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States* (2006).

[11] In the STB rail construction proceeding concerning the Yucca Mountain line proposed by DOE, it has been suggested that DOE should be required, as a condition to approval, to use dedicated trains for all transportation of SNF to the Yucca Mountain line. DOE has opposed that condition, saying only that it will maintain its policy (cited at footnote 3 above) to use dedicated trains as the "usual mode" for transportation to Yucca Mountain.

[12] See the AAR's Senate testimony on May 22, 2007 and July 26, 2007 for details on the many ways that railroads are using technological advances, innovative operating practices, and other means to enhance rail safety.

involving TIH on railroads are extremely rare. However, history demonstrates that railroads could be subjected to multi-billion dollar claims—even for accidents where they do nothing wrong.[13]

Moreover, the revenues that highly-hazardous materials generate do not come close to covering the potential liability to railroads associated with this traffic. Nor can railroads fully insure against the multi-billion dollar risks associated with TIH shipments.[14] This places railroads in an untenable situation.

Given these points, I respectfully submit that if there is a public interest need for railroads to be compelled to carry TIH materials similar to that requiring them to carry SNF, there is a corresponding public interest need for the rail industry to be able to take into account and protect itself against the increased risk and potentially ruinous liability exposure associated with transporting TIH materials—just as railroads (and others) are protected to a limited degree from liabilities associated with SNF.

This can be achieved if policymakers enact a Price-Anderson type solution. The AAR has a legislative proposal which would effect a Price-Anderson type solution for TIH transport and would be pleased to discuss it further with the Committee.

Conclusion

Thank you for the opportunity to testify. Nothing is more important to railroads than the safety of their employees, their customers, and the communities they serve. The railroad industry is committed to working with its employees, Congress, the FRA, its customers, and others to ensure that rail safety continues to improve.

Senator ENSIGN. I want to thank the panel and I will ask a few questions and let Senator Thune ask a few questions. And if I have other followup, I will continue with that.

I want to follow up on some of the questions that I asked in the first panel about the accidents and a few of you have had some comments on that.

First of all, Dr. Crowley, the National Academy of Sciences, can you address the full-scale models versus what DOE has been testing and why you think that full-scale models are important to do?

Dr. CROWLEY. I would be happy to do that. And it is not testing full-scale models. It is actually testing the articles that are used to transport the spent fuel.

There have been many tests carried out on full-scale articles around the world. They include the regulatory tests. For example, one of the tests that shipping packages are required to pass is a drop of 9 meters onto an unyielding surface, which actually, in terms of the impact forces on the canisters, is more severe than you are likely to see in any kind of a collision.

In addition, in the 1970s, Sandia National Laboratory carried out a number of tests where they crashed casks, full-scale casks, on trailers and trucks and trains against unyielding barriers, and they actually crashed a canister on a trailer with a train. Those canisters are designs that are no longer used today. So those are not really applicable to current-day standards.

In addition, in the U.K., the Electricity Generating Board in the 1980s conducted a test where they put one of their canisters on a

[13] For example, a few years ago in New Orleans, a tank car that railroads did not own containing more than 30,000 gallons of liquid butadiene began to leak. Vapor from the butadiene tank car rolled out across a neighborhood until the pilot light of an outdoor gas water heater ignited it. More than 900 people were evacuated, though no one was killed or seriously injured. The National Transportation Safety Board found that the probable cause of the accident was an improper gasket that a chemical company had installed on the tank car. Nevertheless, a state court jury entered a punitive damages verdict against the railroads involved in the amount of $2.8 billion.

[14] Although TIH materials account for only 0.3 percent of rail carloads, the absolute number of carloads—some 100,000 per year—is 250 times higher than the number of expected SNF carloads. The use of dedicated trains is feasible for a commodity like SNF where very few carloads are involved, but is not feasible for TIH.

train, on a flat car, turned the flat car on its side, put it across the track, and crashed a very heavy locomotive into that canister at about 100 miles an hour.

So those are the kinds of tests that have been carried out.

Let me make one other comment. From an impact point of view, these packages are very robust, and as I said before, the regulatory tests that these canisters have to go through are more rigorous than what you are likely to see in a real-world accident.

That is not necessarily the case for severe fires. There is a 30-minute, fully engulfing test that is required as part of the regulation. As you pointed out earlier, there are certainly fires that burn for periods on the order of much longer than 30 minutes. In fact, I forget when exactly it was. It was in the 1970s or 1980s in the U.K.. There was a very, very severe tunnel fire with petrol cars that burned for several days.

Senator ENSIGN. Did we not have something in Baltimore as well?

Dr. CROWLEY. We had a Baltimore fire as well, but that only burned for a few hours. So this fire was much——

Senator ENSIGN. It is still longer than 30 minutes.

Dr. CROWLEY. It is much longer than 30 minutes. That is right.

As a consequence of that U.K. fire, the U.K. Department of Transport prohibited the carriage of spent fuel trains with flammable materials or passing other trains in tunnels.

And I should say for the Baltimore tunnel fire, whether or not this package is fully engulfed is really important. If you, for example, just have an end of the package that goes into the fire, the heat can conduct away. So you really need to put the entire package in the fire and it needs to be maintained for a long period of time to see the kind of impact that you might be concerned about.

Senator ENSIGN. And that kind of testing has not been done.

Dr. CROWLEY. To my knowledge, it has not been done.

Senator ENSIGN. Anybody else want to make any comments on that?

[No response.]

Senator ENSIGN. Maybe, Dr. Ballard, you have studied—obviously, based on what the terrorists did on 9/11, they looked for weaknesses. I mean, do you not think that they would look—you said you have to put the mind of a terrorist on, not the mind of a regulator or a government oversight official. The mind of a terrorist is going to look for the weaknesses there. If they are going to try to attack one of these, do you not think that would be one of the things they would try to replicate?

Dr. BALLARD. Well, across the United States, we will see lots of geographic locations that would enhance an attack, a tunnel, a bridge, et cetera. I live in Santa Clarita, and we recently had a tunnel fire there that was a very significant incident. It was a series of trucks that on a very rainy day got together in the tunnel, and they melted the frames of the trucks. Now, was it a fully engulfing fire? If a cask had been in that tunnel, what would have happened? The difference between a rail cask and its robustness and a truck cask and its robustness—all of those should be tested using full-scale testing models, and we have not done that, as far

as I know, to date, and I think the testimony today kind of supports that.

Senator ENSIGN. Ms. Schubert, in your testimony, you have been able to find these transportation routes. How easy would it be for a terrorist to kind of get these transportation routes and be able to set up what they would believe an ideal place to attack?

Ms. SCHUBERT. It took us just looking at the basic maps and the EIS and then going in and getting some GIS data and putting layers on it. So it was not that difficult. It took some time and a little bit of effort, but these are the DOE maps just with additional information fleshed out so people have a better idea of what is going on.

And I think it is important to point out, although we are talking mostly rail and probably truck, we are also talking barge transport, which is very slow-moving barges with large casks on them which are going to be very obvious to anybody who is looking for something like that.

Senator ENSIGN. The last question has to do with on-site storage. You mentioned, Dr. Crowley, that onsite storage is a pretty proven technology today. The security—obviously, you do not have to worry about transportation with onsite storage. I do not know if you have expertise in this field, but are you familiar with how long is on-site storage or what are the best guesses for how long on-site dry cask storage would be safe?

Dr. CROWLEY. Well, actually my organization has also published on that aspect as well, so I can talk about that.

Senator ENSIGN. I knew they had. I did not know whether you were familiar with this.

Dr. CROWLEY. Yes. I was actually also study director of that report.

Senator ENSIGN. OK.

Dr. CROWLEY. First of all, let me say that whether or not you store something onsite or you transport it to a repository is a policy choice.

Senator ENSIGN. Correct.

Dr. CROWLEY. We all understand that. This is not a technical choice. It is a policy choice.

As far as storage onsite, you can in principle——

Senator ENSIGN. By the way, some people think it is a technical choice.

Dr. CROWLEY. It is not a technical choice.

Senator ENSIGN. My colleagues do not understand that. They do not understand what you just said. They think it is a policy choice. They think you cannot store it safely onsite. That is the reason everybody wants to get it out of their back yards.

Dr. CROWLEY. Well, let me just make a couple of comments about that because the answer to your question is not a simple answer.

From a technical point of view, you can store that stuff forever onsite. From a technical point of view. What you have to worry about is loss of institutional control, loss of institutional will to continue to take care of that material. If you put it into dry cask storage technology, which is what you can do after about 5 years, you can maintain that on a concrete pad. You have got to keep the casks painted, and maybe after 100 years or so, you might actually

have to bring the fuel out of the cask and replace the cask. You could continue to do that forever.

However, those——

Senator ENSIGN. But it probably good for at least 100 years.

Dr. CROWLEY. That is correct. In fact, we have said that.

However, the nuclear plants will not operate for 100 years, and so after some period of time, those plants will be gone and that spent fuel will be stranded at the site. When you have an operating plant, the owner of the plant has an economic imperative to take care of that fuel. Once the plant is gone, that economic imperative is gone.

Senator ENSIGN. Unless the Federal Government takes title to that onsite. That is a policy question, not a technical question.

Dr. CROWLEY. That would be a policy choice. That is right, yes.

Senator ENSIGN. Anybody else want to comment on that?

Dr. BALLARD. Senator Ensign, one of the things that we have talked here today about is that transporting the material induces or increases the risk. We actually have examples of this. On February 4th, 1985, there was a threat against a shipment campaign, and that threat was that they would crash a plane into a shipment container. That was called in to a corporate headquarters for the power plant. It is reported in the NRC's SSEL document. So we have at least an incident of somebody threatening one of these shipments.

What is not in the SSEL is another significant incident, and that was in Golden Valley, Minnesota on October 27, 1986, where a 39-foot section of track was removed ahead of a train that was carrying SNF. Fortunately, I should say, the shipment was routed—a different train was routed ahead of it. It derailed. It was carrying lumber, and so we did not have a significant incident at that time.

We do think that this is related because right on the wall near where this track was removed was the slogan: "Stop rad waste shipments." This incident is not in the NRC's official SSEL. It is not documented as a potential threat.

So the point here is transporting materials adds new threats. It brings out new adversaries with that creative capability of trying to stop whatever they wish to.

Senator ENSIGN. Thank you.

Senator Thune?

STATEMENT OF HON. JOHN THUNE,
U.S. SENATOR FROM SOUTH DAKOTA

Senator THUNE. Thank you, Mr. Chairman, and thank you, panel, for your insights and your input.

I am very interested in the energy issues. I have been involved with those since arriving here. And I think it is probably one of the big challenges our country faces. It strikes me that there are lots of things that we should probably be doing more of to help address the issue of energy independence. We get about 19 percent of our power from nuclear, about 50 percent from coal.

And if you consider the various policy goals that are sort of laid out as we head into the future, one is increasing the use of electric hybrid cars, which means we are going to have additional demand for electricity, which is going to stretch the supply that we cur-

rently have, and it gets into whole other issues of transmission capability and whatnot. But there is also the goal of limiting carbon emissions, and that too is something that nuclear energy could help address, being a clean fuel.

So I guess the question I have is we have seen in other parts of the world—France, for example, I am told 80 percent of their electric power comes from nuclear. Why is it that it has not taken off more in this country? And I think many of the issues that are being discussed today are perhaps part of that.

But tell me, if you can, whoever would care to answer this question who has any experience or knowledge with the issues of transporting spent fuel in other countries of the world where nuclear is a much bigger part of the energy supply than it is here in the United States and have they experienced some of the same issues and how do they address those.

My number here says 1,500 commercial shipments of spent fuel since 1979—I guess, Director Weber had testified to this—without incident. How do you compare the logistical and technical challenges that we face with these shipments here in this country with those in other places around the world where nuclear is a bigger in terms of the power supply?

Dr. CROWLEY. Well, I will take an initial crack at that. As part of our Going the Distance study, we actually went to Europe and we talked to officials who were involved with and citizens who were concerned about transportation of spent fuel.

As it turns out, in Europe, at least until recently, there has been a great deal more spent fuel transportation. The Honorable Edward Sproat talked about 3,000 shipments. There have been on the order of tens of thousands of shipments in Europe. And the reason for that is that until recently, fuel was not stored very long in the spent fuel pools at the powerplants. Rather, that fuel was sent to be reprocessed both in the U.K. and in France. And so they have very routine shipments of fuel. Those routine shipments go through very large cities. And there are citizens over there who are concerned about that, but the consensus in those countries seemed to be that that is OK.

Recently the number of shipments have decreased as the reprocessing activity has gone down, and now more plants are storing the fuel on their sites rather than sending it for reprocessing.

Senator ENSIGN. Why has the reprocessing activity gone down?

Dr. CROWLEY. Well, there have been a number of reasons. In the U.K., one of the plants, the Thor plant which is used to reprocess oxide fuel, sprung a leak, and so it has been shut down.

Germany has encountered a lot of resistance in transporting spent fuel actually. At one point, they had to call out 30,000 police to protect a spent fuel shipment against protesters. So they have made a policy decision to store that material at the powerplant sites, and all of the powerplants have been required to build storage buildings for that material.

Other countries in Europe have just decided that it is too expensive to send the fuel for reprocessing, and they have stopped. Not all countries, but some countries have just stopped.

Senator ENSIGN. What is Japan doing now? Did they not just build a reprocessing plant?

Dr. CROWLEY. Japan has been sending its spent fuel to Europe to be reprocessed, but they did just recently build a reprocessing facility and they will reprocess their fuel domestically.

Senator THUNE. Could you answer the question as to—one of the issues, of course, with transportation and basically the whole Yucca Mountain thing of getting rid of nuclear waste as opposed to storing, all those things we have debated here for a long time—and Senator Ensign and his colleagues from Nevada have some strong views about the whole Yucca Mountain issue.

But one of the things that we—I have been working with a bipartisan group of Senators who are trying to develop a comprehensive energy policy which includes more incentives for nuclear power in this country. And one of the things that we addressed was the Carter era ban on reprocessing spent fuel. And basically what we called for was a demonstration facility to develop spent fuel reprocessing.

And I guess my question in that regard is, why is that not something in this country that we have been more acceptant of? That is clearly something that in the countries that you just mentioned they have supported. Why is it that we cannot be developing more nuclear power in this country instead of dealing with it and disposing of it at a place like Yucca Mountain, which is very controversial? And I realize the ban is very controversial too. But I would be interested in your thoughts on that, Dr. Crowley, about why that is not something that would not be now, it seems to me at least, more acceptable in this country.

Dr. CROWLEY. Well, as it turns out, when the first generation of commercial nuclear plants were built in this country, the concept was to reprocess the spent fuel, and that is one of the reasons that those plants have such small spent fuel pools. The idea was to store that fuel in the pools for just some matter of months and then send it off to be reprocessed. And there were two or three reprocessing plants that were built or planned to be built in the country. They ran into a number of technical problems and none of those plants—well, one plant in West Valley was operated for a short period of time, but none of the other plants were operated.

Carter did in, I think it was, 1977, ban reprocessing. On the other hand, Reagan overturned that ban in the early 1980s, and yet no reprocessing plants were built. And I think at that point it was a matter of economics.

Right now the price of uranium is fairly inexpensive, and if you are an operator of a nuclear plant, it is much cheaper for you to buy fresh spent fuel and to store that fuel with the idea that you would eventually send it off to be disposed of than it is to reprocess that fuel. And I think that is the reason that you are not seeing a lot of activity for reprocessing in the United States.

Now, as you know, there has been recent interest in reprocessing, and I know that one of the French companies has asserted that, in fact, it is economical to reprocess. But I have not reviewed that material, and so I do not really have an opinion on that.

But historically it has been false starts early on and now economics.

Senator THUNE. Well, that is good to know. I did not realize that economics played that big of a role in that. It just seems like if that

is something that we could open up a little bit, but if it is, in fact, not going to be economical for companies to do that—it seems to me that it bears on the whole issue of transportation too because my assumption is if you have reprocessing plants different places, it probably limits the amount of transportation that is necessary to get everything out to Yucca or someplace for disposal like that. I would assume those would be all around the country and would minimize the distance that some of the spent fuel would have to be transported.

Dr. CROWLEY. Well, let me make a couple of comments about that. Right now, as you know, the owners of nuclear power plants are spending a tenth of a penny per kilowatt hour to get their fuel disposed of, and it is the Government's responsibility to dispose of that fuel. So I think from the perspective of the commercial spent fuel owners, they would say, hey, we have already paid for this. Why should we pay twice?

Reprocessing plants are very expensive. Japan spent over $20 billion on its reprocessing plant. I forget what its capacity is. Several hundred or a couple of thousand of metric tons per year. So it would be very expensive to build a lot of reprocessing plants.

Senator THUNE. You do not see then multiple reprocessing plants.

Dr. CROWLEY. Certainly not initially, no.

And then also, reprocessing does not eliminate the need for disposal. You are going to reprocess the fuel. You are going to recover its useful components, but the waste still has to go somewhere. You could store it onsite at the reprocessing plant. Some of the shorter-lived radioactivity would decay away, but there would be a longer-lived component that would have to be disposed of eventually.

Senator ENSIGN. The volume is tremendously less, though. Is it not?

Dr. CROWLEY. Not necessarily. It depends on the reprocessing approach that you use. The current approach, which is based on PUREX, would not reduce the volume. The Department of Energy is trying to develop advanced reprocessing technologies. They claim it would reduce the volume. And the other thing that that would do for you would be to allow you to separate out the different kinds of radioactivity. So a lot of it you could just store for a couple of hundred years to decay.

Senator ENSIGN. Is that the accelerator technology that they are talking about?

Dr. CROWLEY. Well, they are talking about—instead of PUREX, it is called UREX. It is just an advanced reprocessing that allows you to take the spent fuel, dissolve it, and separate out its components.

Now, there is another option when you can take some of the long-lived components of the fuel, put it into a reactor or an accelerator, and transmute it to reduce its long-term toxicity.

Senator ENSIGN. That is more theoretical still. Right?

Dr. CROWLEY. Exactly. That is not ready for deployment at this point.

Senator ENSIGN. Right. That is what I understand.

I want to thank the panel.

Also, just one last comment. Also, it had to do with weapons-grade plutonium was the reason I think Carter stopped the reprocessing as well, although it looks like Europe and Japan have answered that. From what I understand vitrification takes care of that problem. It makes it unusable to ever have weapons-grade plutonium.

Dr. CROWLEY. That is not actually true. What they are doing is separating out the fission products, and that material has no use other than to a terrorist who might want to build a dirty bomb. But the plutonium is actually being separated out and it is being stored. And that is a real concern. We are not so concerned when countries like France and the UK and Japan do that because they are allies, but we would be very concerned if other countries that were not allies started to do that.

Senator ENSIGN. In this issue, we are just talking about it here in this country.

So, listen, it has been a fascinating couple of panels. I want to thank both panels for your expert testimony, and we will see where this leads. Hopefully, it will not lead to Yucca Mountain. Thank you.

[Whereupon, at 3:50 p.m., the hearing was adjourned.]

A P P E N D I X

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DANIEL K. INOUYE TO HON. EDWARD F. SPROAT III

Question. The DOE will have the authority to begin shipments to Yucca Mountain if the NRC approves the license application for construction authorization, which could very quickly lead to the large quantities of nuclear waste being shipped to Yucca Mountain. What steps has the DOE taken to prepare the public for the increase in these shipments? Has the DOE been actively addressing public concerns over these shipments?

Answer. Since passage of the Nuclear Waste Policy Act (NWPA) in 1982, DOE has been working with its stakeholders to identify, address, and resolve issues of concern related to the transport of spent nuclear fuel and high-level radioactive waste. DOE has worked with law enforcement, emergency response, and public safety officials from potentially impacted States, Tribes, and local governments to communicate information about spent nuclear fuel transportation. As specific concerns arc identified, DOE has addressed them through outreach programs and in discussions at Transportation External Coordination Working Group conferences. DOE has also maintained cooperative agreements with State Regional Groups (*e.g.,* the Western Interstate Energy Board), public safety organizations (*e.g.,* the Commercial Vehicle Safety Alliance), and legislative organizations (*e.g.,* the National Conference of State Legislatures), all specifically for the purpose of addressing concerns and helping corridor communities prepare for the planned shipments. DOE additionally has responsibilities under Section 180(c) of the NWPA to provide funding and technical assistance for training to states and tribes and will make such funding available.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BARBARA BOXER TO HON. EDWARD F. SPROAT III

Question 1. When will routes and shipment schedules be established? Will the public have access to the route information? If not, why not?

Answer. The selection of truck routes will be made in accordance with DOT routing regulations set forth in Title 49 of the Code of Federal Regulations. The selection of railroad routes will be the responsibility of the carriers, as specified in Title 49 of the Code of Federal Regulations. DOE is working with stakeholders to establish routing criteria and will work in close cooperation with the carriers to ensure that routes selected will be safe, secure, and efficient. Authorized officials will be provided specific routes and shipping schedules as part of the NRC required prenotifications that will be made before each shipment. Specific routes and shipping schedules will not he available to the general public for security reasons.

Question 2. How much of the spent nuclear fuel are you expecting to be transported over highways rather than rail? Are TAD canisters being developed that can be transported by tractor trailers?

Answer. DOE estimates about 10 percent of the spent nuclear fuel to Yucca Mountain will be shipped by truck. The TAD canisters currently being designed will be shipped to the repository using rail.

Question 3. How will the Department of Energy ensure the security of shipments to Yucca Mountain?

Answer. The Department is committed to ensuring the security of shipments to Yucca Mountain and will meet or exceed the level of security provided by following the current regulations and additional measures put in place by the Nuclear Regulatory Commission, the Department of Transportation (DOT), and the Department of Homeland Security.

DOE coordinates with these entities to continually assess potential developments that could affect security. In addition, DOE will work with Federal, State, Tribal

and local law enforcement, as appropriate, to fulfill our shared responsibilities for spent nuclear fuel transportation safety.

Question 4. Why has DOE not analyzed which specific rail and truck routes to Yucca Mountain have the least risk of accident and/or sabotage and the least risk of environmental, economic, and human health impacts in the event of accident and/or sabotage?

Answer. Under applicable regulations specific routing selections cannot be made until nearer to he time of shipments. Nevertheless, in its NEPA documentation relating to the Yucca Mountain repository, DOE has analyzed representative routes and has also analyzed the risk of accidents, transportation sabotage considerations, and consequences of potential sabotage events.

Question 5. Why shouldn't the analysis of the relative risks of specific rail routes be done now, prior to licensing, instead of after licensing? When will DOE complete such an analysis?

Answer. Under applicable DOT regulations, specific trucking and rail routing decisions cannot be made until nearer the time of shipments. Under those regulations, specific rail routing decisions will be made by the rail carriers pursuant to the regulations in effect at the time of the shipments.

As a general matter, however, the DOT's Pipeline and Hazardous Materials Safety Administration. in coordination with the Federal Railroad Administration and the Transportation Security Administration, has recently issued a final rule revising requirements in the Hazardous Materials Regulations applicable to the safe and secure transportation of certain hazardous materials transported in commerce by rail. The final rule requires rail carriers to compile annual data on these shipments, use the data to analyze safety and security risks along rail routes where those materials are transported, assess alternative routing options, and make routing decisions based on those assessments to select the safest and most secure practicable route. Under the new rule, the railroad carriers are developing their processes for conducting these assessments, on a national scale, taking into account the many thousands of shipments of toxic gases, explosives, and poisons that must be handled safely and securely every day. DOE is monitoring how rail shippers and carriers of such toxic materials are implementing this new rule. DOE is also working with DOT and the railroads to better understand how such assessments arc to be conducted, and how spent nuclear fuel shipments need to be considered in such analyses.

Question 6. Will DOE contractually bind carriers it contracts with to use those rail routes that DOE has determined to be safest? If not, why not?

Answer. DOT's new rail routing rules require the carriers to use the routes the carriers consider safest and most secure, subject to DOT's review. DOE contract incorporate DOE Directives that require DOE contractors to follow these and all other applicable DOT regulations when transporting material on behalf of DOE.

Question 7. When does DOE plan to perform an environmental review under the National Environmental Policy Act for its National Transportation Plan and National Operational Plan?

Answer. In 2002, DOE issued its *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* DOE/EIS–0250F, and in 2008 issued its final *Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada—Nevada Rail Transportation Corridor,* DOE/EIS–0250F–S–2 and its final *Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada,* DOE/EIS–0369. These documents analyze the potential impacts associated with the transportation of spent nuclear fuel and high-level radioactive waste to the Yucca Mountain repository. The National Transportation Plan and National Operation Plan that will be developed are planning documents that implement the proposed action which was already analyzed in these National Environmental Policy Act (NEPA) documents. DOE would conduct supplemental NEPA review if DOE makes substantial changes in the proposed action or there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impact.

Question 8. Will DOE require that all nuclear waste shipped by rail to Yucca Mountain be carried in dedicated trains, or will it allow some nuclear waste to be shipped in general freight service? Will DOE analyze and compare the risk between a dedicated train and general freight service, particularly as to railroad route segments that present particular challenges to longer trains?

Answer. In July 2005, DOE adopted a policy to use dedicated trains as its usual mode of rail transportation for shipments of commercial spent nuclear fuel and high-level radioactive waste to the Yucca Mountain repository. In adopting this policy, however, DOE has recognized that such materials can be shipped safely regardless of mode and regardless of type of service due primarily to the stringent regulations in place and the robust nature of the transport packages involved. In adopting the policy, DOE has additionally identified the primary benefit of using dedicated trains to be the significant costs savings over the lifetime of the Yucca Mountain Program. However, there may also be circumstances where general freight service would be more appropriate to promote costs savings, operational flexibility and/or efficiency for shipments to the Yucca Mountain repository.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. HARRY REID TO HON. EDWARD F. SPROAT III

Question 1. If the Department of Energy (DOE) is able to maintain its current schedule for licensing and building the Yucca Mountain nuclear waste repository, when is the soonest you could begin transporting nuclear waste? Would the DOE consider shipping nuclear waste prior to completing construction at Yucca?

Answer. Under the Nuclear Waste Policy Act, the Department of Energy (DOE) could not begin transporting spent nuclear fuel and high-level radioactive waste to the Yucca Mountain repository until the Nuclear Regulatory Commission (NRC) issues a construction authorization license and a repository license to receive and possess spent nuclear fuel and high-level radioactive waste for disposal. Under current planning, the earliest date that DOE anticipates that it would begin transporting waste to the Yucca Mountain repository is 2020.

Question 2. In 2007, the DOE officially gave Congress draft legislation that would abolish Department of Transportation (DOT), Nuclear Regulatory Commission (NRC), Surface Transportation Board, and state authority over transportation of nuclear waste. Does the DOE still support this legislation? Will the DOE be able to ship waste if Congress does not eliminate these other agencies' authorities over nuclear waste shipments?

Answer. The Department supports the proposed legislation which would not abolish or otherwise change the existing authority of DOT, NRC, the Surface Transportation Board, states and other entities over transportation of nuclear waste by or on behalf of DOE. Rather, Section 7 of the proposed legislation would clarify the manner in which the Department may exercise its existing authority to regulate the safety and security of transportation of radioactive materials to Yucca Mountain. DOE has broad authority under the Atomic Energy Act of 1954, as amended (AEA), to regulate all aspects of activities involving radioactive materials that are undertaken by DOE or on its behalf, including the transportation of radioactive materials. DOE exercises this authority to regulate certain DOE shipments, such as shipments undertaken by governmental employees or shipments involving national security. In most cases where DOE utilizes commercial carriers, however, DOE does not exercise its AEA authority but rather relies on regulation of these shipments by DOT, NRC and other entities as appropriate. With respect to shipments to Yucca Mountain, DOE currently plans to use commercial carriers regulated by DOT.

As a policy matter and without regard to which agency exercises regulatory authority, DOE requires shipments by it or on its behalf to be undertaken in accordance with the requirements and standards that apply to comparable commercial shipments, except where there is a determination that national security or another critical interest requires different action. This policy is set forth in DOE Orders 460.1B, Packaging and Transportation Safety, 460.2A, Departmental Materials Transportation and Packaging Management, and 470.4A, Safeguards and Security Program, as well as DOE Manual 460.2–IA, Radioactive Material Transportation Practices Manual. In implementing this policy, DOE will cooperate with Federal, State, local and Tribal entities and utilize existing expertise and resources to the extent practicable. In all cases, DOE is committed to achieving a level of protection that meets or exceeds the level of protection associated with comparable commercial shipments regulated by DOT and NRC.

Question 3. CSX Transportation recently expressed concern that the DOE could be reversing its plan to use dedicated railcars for shipping spent nuclear fuel. CSX stated that the DOE is now stressing the need for "flexibility" so they can reserve the option of shipping spent fuel together with other commercial items. Is the DOE reversing its position and if so, why does the DOE now think it is safe to transport commercial and nuclear shipments together?

Answer. In July 2005, DOE adopted a policy to use dedicated trains as its usual service mode of rail transportation for shipments of commercial spent nuclear fuel and high-level radioactive waste to the Yucca Mountain repository, and that policy has not changed. In adopting the policy, DOE has recognized that such materials can be shipped safely regardless of mode and regardless of type of service due primarily to the stringent regulations in place and the robust nature of the transport packages involved. In adopting the policy, DOE has additionally identified the primary benefit of using dedicated trains to be the significant costs savings over the lifetime of the Yucca Mountain Program. However, there may also be circumstances where general freight service would be more appropriate to promote costs savings, operational flexibility and/or efficiency for shipments to the Yucca Mountain repository.

Question 4. The National Academy of Sciences, the Government Accountability Office and even the state of Nevada have recommended that the oldest spent nuclear fuel should be shipped first. They claim that storing nuclear waste at the reactor for 50 years or more before shipping it can reduce public health risks from radiation by up to 85 percent. The Academy also notes that this will reduce the consequences of a terrorist attack. So why hasn't the DOE considered shipping older fuel first in its environmental impact statements (EIS)?

Answer. In developing the impact analyses in its environmental impact statements. DOE used conservative, "bounding" assumptions. This is a standard risk assessment practice to ensure the actual impacts likely to occur will be less than—in some cases, much less than—the calculated estimate of impacts. The age and radioactivity level of the fuel is one example. In DOE's analyses, the Department has assumed that every shipment of spent nuclear fuel would have the very highest level of radioactivity permissible by Federal regulation, every single time, which in reality is not possible (older fuel already exists). DOE's analysis showed that, even if every shipment had the very highest levels permissible, the shipments would still pose a very low risk. The fuel in any particular shipment, regardless of age, does not present a safety or security issue so long as the material is packaged and transported in accordance with the strict regulations that apply to such shipments.

Question 5. In May, Holtec International—a firm that submitted a bid to design the transportation canisters for the DOE—said that an earthquake at Yucca Mountain would send the casks into a "chaotic melee of bouncing and rolling juggernauts" if it were to rely on the DOE's specifications. The firm said that "pigs will fly before the cask will stay put." Has the DOE taken any steps to respond to Holtec's concerns?

Answer. In June 2008, DOE submitted its license application for authorization to construct the repository, and in September 2008, NRC docketed and commenced its detailed review of the application. The NRC will conduct a thorough and rigorous review, pursuant to NRC's applicable regulations, of DOE's license application and will determine the adequacy and safety of the repository. The NRC will similarly conduct a rigorous and thorough review of the applications that will be submitted for certificates of compliance for the casks used to transport and age spent nuclear fuel onsite.

Question 6. Why hasn't the DOE requested an independent assessment of nuclear waste transportation security, as was recommended by the National Academy of Sciences in their 2006 report?

Answer. DOE agrees with NRC's position that security measures for future shipments must defend against the threat that exists at the time of that shipment, and take advantage of enhancements in technology then available. Since these factors may change over time and shipments to the Yucca Mountain repository are not expected to begin until 2020 at the earliest, it would be more appropriate to conduct an independent security assessment closer to the time of actual shipments. DOE, nevertheless, is currently a participant in a Multilateral Agreement with Great Britain, France and Germany to conduct classified laboratory tests that would accurately measure the impacts of sabotage events on spent fuel. These tests will inform future security assessments.

Question 7. Has the DOE made public its plan for selecting national rail and truck routes, as recommended by the National Academy of Sciences?

Answer. DOE has addressed routing in its National Environmental Policy Act (NEPA) documentation relating to transportation, both nationally and in Nevada, of spent nuclear fuel and high-level radioactive waste to Yucca Mountain. Truck shipments will be shipped in accordance with DOT regulations, using preferred routes that reduce time in transit. A preferred route is an Interstate system highway selected by a State or Tribal routing agency in accordance with applicable DOT regulations. Under those regulations, substantive consultation with affected jurisdictions

would be required prior to designating an alternative route to ensure consideration of all impacts and continuity of designated route.

Rail shipments would be shipped using routes selected by the rail carriers, which have responsibility for selection of rail routes. Railroads are privately owned and operated, and shippers and rail carriers determine routes based on a variety of factors. Route selection for shipments to Yucca Mountain would involve discussions between DOE and the chosen rail carriers, with consideration of input from other stakeholders. While Federal rules do not prescribe specific routes for spent nuclear fuel and high-level radioactive waste shipments by rail, certain factors must be considered in route selection.

DOE anticipates that it will identify a preliminary suite of national routes 5 years prior to shipments in order to identify states and tribes that will be eligible for technical assistance and funds for training under Section 180(c) of the Nuclear Waste Policy Act. Over the past several years, the DOE has engaged in discussions with rail carriers and other stakeholders on issues related to routing.

Question 8. Has the DOE established a social risk advisory group, as recommended by the National Academy of Sciences?

Answer. As the National Academy of Sciences recommended, DOE has engaged stakeholders on methods to communicate about transportation safety, and is currently exploring the formation of an advisory group chartered under the Federal Advisory Committee Act to provide input on a range of transportation issues, including the public perception of risk.

Question 9. What is the DOE's contingency plan for transporting waste to Yucca Mountain in the event that rail access to Yucca is not available by the time Yucca is opened? Was this considered in the DOE's Rail Alignment EIS?

Answer. In order to operate efficiently and meet its obligations under the Nuclear Waste Policy Act, DOE needs to have direct rail access to the Yucca Mountain repository. The facility will be able to accept truck shipments of spent nuclear fuel, but rail access will be required to efficiently ship larger transportation, aging and disposal (TAD) canisters that are the basis of the repository design. DOE plans for the railroad to be available before commencement of shipments of spent nuclear fuel and high-level radioactive waste. If the railroad were not initially available, however, DOE anticipates that it would consider shipments of spent fuel in small truck casks that are included in the scenarios analyzed in the Department's NEPA documentation relating to the Yucca Mountain repository.

Question 10. Out of 72 commercial sites with nuclear waste, 24 of them do not have railroad access. That means the DOE will have to haul waste by truck from at least one third of nuclear reactors. Does the DOE plan to truck the waste to the railroad? Has the DOT approved this approach, given that they are highly concerned about unnecessary stops during transport?

Answer. Sites without direct rail access will be serviced by heavy-haul trucks to transport rail casks to a nearby railhead. If a site were unable to accommodate a rail cask. a smaller, truck cask would be used on standard size semi-truck trailers. Intermodal transfers are common in the transportation industry, and the logistical challenges are well-understood. At this time, more than 10 years before shipments, potential site-specific transportation infrastructure issues cannot be known with any degree of certainty. DOE also evaluated the use of barge transportation for transporting rail casks to nearby railheads from generator sites near navigable waterways but not served by railheads.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DANIEL K. INOUYE TO MICHAEL WEBER

Question. The National Academy of Sciences has recommended an independent examination of the security of spent nuclear fuel and high-level radioactive waste transportation prior to the commencement of large-quantity shipments to an interim or final repository. Has the NRC had difficulties working with the DOE to request this type of examination? Why hasn't the NRC requested an independent assessment of nuclear waste transportation security? What is the NRC currently doing to expand the knowledge base for the secure transportation of nuclear waste?

Answer. The DOE, the U.S. Department of Transportation (DOT) and NRC have a long history of working together cooperatively on transportation safety and security issues, including their joint sponsorship of the National Academy of Sciences' (NAS) recent study on the transportation of spent fuel. The principal finding of the NAS study was:

> The Committee could identify no fundamental technical barriers to the safe transport of SNF and HLW in the United States. Transport by highway (for small-quantity shipments), and by rail (for large-quantity shipments) is, from a technical viewpoint, a low-radiological-risk activity, with manageable safety, health, and environmental consequences, when conducted with strict adherence to existing regulations.

The NRC takes this study's recommendations very seriously and addressed them in our program, including preparations for full-scale testing in the U.S. and additional analyses of long-duration, fully engulfing fires. The NAS study also recommended that, ". . . an independent examination of the security of spent fuel and high-level waste transportation should be carried out prior to the commencement of large-quantity shipments to a Federal repository or to interim storage." At present, the NRC is not planning to conduct an independent security assessment with DOE that would cover both shipments to Yucca Mountain and to an interim storage facility because NRC security assessments have shown that current security measures and standards put in place since September 11, 2001, are adequate for the protection of spent fuel and high level waste transportation even in the event of increased shipping campaigns. Specifically, in light of the elevated threat that the U.S. experienced following the terrorist attacks on September 11, the NRC issued safeguards advisories and orders to enhance transportation security of spent nuclear fuel and other large quantities of radioactive material. The NRC issued these security enhancements in coordination with DOT, the Department of Homeland Security, State agencies, and other Federal agencies. The NRC security assessments of transportation, which were completed after the publication of the NAS report, evaluated a number of representative transportation package designs against a variety of credible land-based threats and a deliberate plane crash. The results of these security assessments, which we have shared with DOT, DOE, and other organizations that have a "need to know," demonstrate that the current requirements, combined with the security enhancements put in place after September 11, provide adequate protection of public health and safety, and the environment, and common defense and security. These safeguards advisories and orders are only an interim solution and will not be relied on indefinitely. In late 2009, the NRC intends to issue a proposed rule for public comment that would revise the requirements for secure transport of spent nuclear fuel; the proposed rule would include additional measures to address the current threat environment.

Physical protection measures for future shipments must match the threat in place at the time of shipment. In addition, shipment tracking and monitoring technologies are constantly improving. The NRC would be responsible for overseeing the security requirements for commercial shipments to an interim storage facility and DOE would be responsible for implementing and overseeing the security requirements for Yucca Mountain shipments. Shipments to Yucca Mountain would not begin, at the earliest, until 2020, based on current DOE estimates. This estimate is tentative, given that NRC staff continue to review the DOE license application to construct and operate the repository. Therefore, it would be more appropriate to consider whether an independent examination of shipment security is needed closer to the time of actual shipments. To expand the knowledge base for the secure transportation of nuclear waste, the NRC has recently completed, through contract with Sandia National Laboratories, a number of security assessments on representative spent fuel transportation package designs. The NRC believes that these spent fuel transportation package assessments demonstrate that the stringent safety standards applied to the design of spent fuel packages provide substantial protection from security threats. NRC is considering the merits of releasing non-sensitive summaries of current spent fuel transportation package security assessments in partial response to the NAS study recommendation.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BARBARA BOXER TO MICHAEL WEBER

Question 1. If the Department of Energy is responsible for shipments of waste to Yucca Mountain, what will be the role the Nuclear Regulatory Commission?

Answer. Because the Department of Energy (DOE) plans to take custody of the spent fuel at the licensee's site (*i.e.,* at a nuclear power plant), the NRC's role in the transportation of spent fuel to a repository would be limited to certification of the designs for shipping casks used for transport and, in the event of a transportation incident, providing technical expertise, if requested. Section 180(a) of the Nuclear Waste Policy Act of 1982 prohibits the Secretary of Energy from transporting spent nuclear fuel or high level waste to a repository or monitored retrievable stor-

age facility except in packages certified for such purpose by the NRC. Physical security and transportation safety for these shipments would be addressed under DOE and the Department of Transportation's requirements.

Question 2. Is the NRC planning to do an independent security assessment with DOE that would cover both shipments to Yucca Mountain and to an interim storage facility?

Answer. At the current time, NRC is not planning to conduct an independent security assessment with DOE that would cover both shipments to Yucca Mountain and to an interim storage facility. Current security measures and standards put in place since September 11, 2001, are adequate for the protection of spent fuel and high-level waste transportation even in the event of increased shipping campaigns. Physical protection measures for future shipments must match the threat in place at the time of shipment. In addition, shipment tracking and monitoring technologies are constantly improving. Shipments to Yucca Mountain could not begin, at the earliest, until 2020, based on current DOE estimates. This estimate is tentative given that NRC staff continue to review the DOE license application to construct and operate the repository. Therefore, it would be more appropriate to consider whether an independent examination of shipment security is needed closer to the time of actual shipments.

Question 3. Please explain the NRC's physical protection requirements for the transportation of spent nuclear fuel as they would relate to the transport of spent nuclear fuel to Yucca Mountain. What is the process for advance notification of State Governors prior to a shipment?

Answer. As DOE plans to take custody of the spent fuel at the NRC licensee's site, DOE requirements would control the physical security of spent fuel shipments. NRC's physical protection requirements would not apply.

However, Section180(b) of the Nuclear Waste Policy Act requires that the Secretary of Energy abide by the Commission's regulations regarding advanced notification of State and local governments prior to transportation of spent fuel or high-level waste to Yucca Mountain. NRC's advanced notification requirements in 10 CFR 73.37(f) require an NRC licensee to notify the Governor or Governor's designee at least 4 days prior to a spent fuel shipment within or through a state. Notifications delivered by mail must be postmarked at least 7 days prior to shipment.

Question 4. You mention in your testimony that you are examining the MacArthur Maze accident in Oakland and the I–5/14 interchange tunnel fire in Northern Los Angeles County as part of your efforts to improve the security of commercial shipments of spent nuclear fuel. Will you share a copy of the results when your studies are completed?

Answer. Yes. The MacArthur Maze accident and 1–5/14 interchange tunnel fire studies are focused on how spent fuel casks would perform under real world accident conditions involving severe fires. The studies are not specifically focused on security-related scenarios, although the studies could be used to inform the assessment of sabotage or security scenarios involving severe fires. NRC is planning to publish the draft reports for the MacArthur Maze accident in Oakland and the 1–5/14 interchange tunnel fire in Northern Los Angeles County for public comment. We anticipate that the draft reports on both accidents will be published in mid-calendar year 2009. The NRC's Office of Congressional Affairs will provide your office a copy of the draft reports as soon as they are published. The NRC will also notify the public of the reports' availability and seek public comments by *Federal Register* notice and by making the reports available on the NRC's public website. The final reports will be issued after public comments are considered. The NRC's Office of Congressional Affairs will provide your office a copy of the final reports

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RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. HARRY REID TO MICHAEL WEBER

Question 1. The U.S. Nuclear Regulatory Commission (NRC) has recorded at least four accidents involving spent nuclear fuel shipments over the past 30 years. Please tell the Committee about those accidents and how the NRC responded.

Answer. The NRC is aware of four transportation accidents since 1971 that have involved loaded spent fuel casks in transit. These accidents are summarized in the table below. When accidents involving spent fuel shipments occur, State and local governments have the primary responsibility to respond. Therefore, these accidents were handled at the State and local level, with assistance from the carriers and shippers.

Transportation Accidents involving Commercial Spent Fuel Casks (1971–Present)

Mode	Date	Location	Description
Truck	December 8, 1971	Tennessee	Cask thrown free of trailer following head-on collision with automobile. Minor cask damage and no release. Driver killed.
Truck	February 2, 1978	Illinois	Trailer collapsed while crossing railroad tracks. No cask damage or release.
Truck	December 9, 1983	Indiana	Trailer separated from its axles. No cask damage or release.
Rail	March 24, 1987	Missouri	Train-auto collision at grade crossing. Train carrying two casks of Three Mile Island core debris. No cask damage or release.

Question 2. While the risk for a major accident involving a nuclear waste shipment is not great, it still exists and one major accident after thousands of successful shipments would mean this entire program is a failure. How is the NRC prepared to respond to a worst-case scenario situation, in which there is a major radioactive release on a railway or a highway?

Answer. The likelihood of highway or rail accident occurring that results in a major release of radioactive material is extremely low. This assessment is based on the outstanding safety record of spent fuel shipments during the past thirty years, numerous transportation shipment risk assessments completed by both the NRC and other Federal Agencies, an independent assessment of spent fuel transportation safety published by the National Academy of Sciences in 2006, and the technical knowledge gained from the actual physical testing of spent fuel casks conducted both within the United States and abroad.

In the event that an accident involving a spent fuel shipment occurs, State and local governments have the primary responsibility to respond. The NRC is prepared to respond by providing technical expertise if requested, to support State and local governments in their response. In an extremely unlikely accident scenario involving a major release of radioactive material on a railway or a highway, NRC would support a coordinated Federal response under the Nuclear/Radiological Incident Annex of the National Response Framework.

In accordance with the Nuclear/Radiological Incident Annex, the Federal Department or Agency responsible for the material involved in the accident would coordinate the response of other Federal Departments and Agencies, including the deployment of specialized equipment and personnel. The Department of Energy (DOE) is the coordinating agency for transportation incidents involving DOE materials. Therefore, if DOE takes custody of spent fuel prior to shipment to Yucca Mountain, DOE would be the coordinating agency for transportation incidents. In this case, NRC is prepared to provide technical expertise. For shipments to sites other than Yucca Mountain, the NRC is prepared to act as the coordinating agency for transportation incidents that involve the shipment of radiological material by NRC or Agreement State licensees.

The NRC is also prepared to support the Department of Homeland Security in those circumstances under which they take a lead role in coordinating the Federal response under the National Response Framework.

Question 3. The NRC reports prepared in the late 1970s estimated that sabotage of a spent fuel shipment in an urban area could cause hundreds of early fatalities, thousands of latent cancer fatalities and economic losses in the billions. In 1979, the NRC promulgated regulations to safeguard shipments from sabotage and terrorism. Has the NRC reconsidered these regulations or made any significant changes to them over the past 30 years?

Answer. Yes, the NRC continually evaluates its regulations based on new information.

With regard to the reports, the NRC published two reports in the mid-1970s: *Calculations of Radiological Consequences from Sabotage of Shipping Casks for Spent Fuel and High Level Waste,* NUREG–0194, February 1977, and *Final Environmental Statement on Transportation of Radioactive Material by Air and Other Modes,* NUREG–0170, December 1977, that estimated the health effects of a radiological release in a non-urban area and determined that the estimated risks were not considered substantive enough to warrant regulatory action. Sandia Laboratories also issued a study in 1977, *Transport of Radionuclides in Urban Environs:*

A Working Draft Assessment, SAND 77–1927, suggesting that the sabotage of spent fuel shipments had the potential for producing serious radiologic consequences in areas of high population density. In response to the Sandia study, the NRC issued interim safeguard measures for spent fuel shipments in an interim rule published on June 15, 1979. The physical protection requirements were subsequently modified based on public comments in a final rule dated June 3, 1980.

The Sandia report (SAND 77–1927) contained estimates which were subject to large uncertainties due to lack of technical data. As a result, NRC and the Department of Energy sponsored research programs to yield information about the potential for radiological releases from sabotage events. The research supported a conclusion that the potential releases from sabotage events were a tiny percentage of the values estimated in the Sandia report (*e.g.,* no early fatalities and seven latent cancer fatalities). The interim safeguard measures were subsequently modified to reflect the research results and the modified measures were incorporated into NRC regulations by public rulemaking on June 8, 1984.

After the attacks of September 11, 2001, the NRC determined that additional security measures were necessary during the transport of spent nuclear fuel and that the existing regulations should be enhanced to further protect spent fuel during transport. The NRC began issuing orders to licensees shipping spent nuclear fuel in October 2002. Only those licensees currently shipping or expecting to ship spent fuel in the near future received the initial order. Since 2002, the staff issued additional orders to licensees transporting spent fuel when these licensees indicated their intention to ship, The orders imposing additional security measures during shipments of spent nuclear fuel are an interim solution, pending rulemaking, as described below.

The NRC initiated a rulemaking in September 2008 to enhance the in-transit security requirements of 10 CFR Part 73 consistent with the security measures imposed by the post-9/11 orders. These measures include: assuring consistent physical protection along the entire shipping route; pre-planning and coordination of a shipment with the states; communications among the transporters, escorts, local law enforcement agencies, and movement control centers; trustworthiness and reliability of individuals associated with the shipment; and normal and contingency procedures and training of individuals associated with the shipment, The proposed rule is expected to be published in late 2009 for public comment, with the final rule expected to be issued in late 2010-early 2011.

Question 4. Since the attacks against America on September 11, 2001, the NRC has studied the vulnerability of nuclear waste transportation containers. Why haven't the results of these studies been made available to the applicable state and local governments? If states and local governments are going to be involved in the transportation planning process, shouldn't they have more information about the risks involved? What can be done to involve state and local governments in the transportation planning process?

Answer. The Commission understands the importance of this information in enabling State and local governments to plan for the safety and security of spent fuel shipments, especially in their emergency response roles and responsibilities, and intends to ensure that they have the information they need to exercise these roles and responsibilities. In late 2006, the NRC began a dialogue with representatives of State Regional Transportation Groups aimed at sharing information from the NRC spent fuel transportation package security assessments with State and local governments to help them prepare more effectively for their emergency response and law enforcement responsibilities. This ongoing dialogue includes a discussion of what information (related to the spent fuel transportation package security assessments) is needed, how and by whom such information would be used, and how shared sensitive information would be protected. These groups include transportation safety task forces established through the Western States Energy Board, the Southern States Energy Board, and the Council of State Governments, Midwestern and Northeast States Divisions. Collectively, the state regional groups contain state representatives from all of the states that have potential transportation routes to Yucca Mountain.

Question 5. In 2001, 11 train cars derailed while passing through the Howard Street Tunnel in Baltimore, Maryland, setting off a fire that lasted for days and was 1800 degrees Fahrenheit. Could the Department of Energy's (DOE) proposed multi-use transportation casks withstand such an accident?

Answer. The NRC staff has extensively evaluated the Baltimore Tunnel fire of 2001, along with other severe accidents as part of its efforts to ensure the safety of radioactive material transportation. In November 2006, NRC released a study that focused on how three representative spent fuel cask designs would have per-

formed if they were involved in the Baltimore Tunnel fire *(Spent Fuel Transportation Package Response to the Baltimore Tunnel Fire Scenario,* NUREG/CR6886, Rev.1., November 2006). The cask designs analyzed included the NAC–LWT truck cask, and the HOLTEC HI–STAR 100 and TN–68 rail casks. The study concluded that the fire, if it had involved spent fuel casks, would not have caused a release of radioactive material from the spent fuel for any of these three cask designs.

The Baltimore Tunnel fire study did not specifically consider DOE's proposed multi-use transportation casks, as the designs for these casks are still being finalized and have not yet been submitted to the NRC for review. Therefore, it would be premature to make a definitive judgment as to how DOE's proposed multi-use transportation cask designs would perform. However, we believe that DOE's proposed multi-use transportation rail cask designs would be similar in size, weight, and configuration to the rail casks we analyzed in our 2006 Baltimore Tunnel fire study.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DANIEL K. INOUYE TO EDWARD PRITCHARD

Question. The DOE is advocating for legislation that would give the DOE authority to preempt the Department of Transportation's (DOT) regulation of the transportation of nuclear waste. Is this something you support? Do you think it is necessary to preempt DOT regulations to facilitate a massive nuclear waste shipping campaign? How would that affect the safety of such shipments?

Answer. SNF/HLRW has been successfully shipped by rail for the past 50 years. The exemplary safety record associated with these shipments over this time-frame leads FRA to firmly believe that SNF/HLRW can be safely and securely transported by rail from its current locations throughout the country to Yucca Mountain. FRA strongly believes, however, that the cornerstone of this exemplary safety record is application of the comprehensive regulatory framework and effective oversight by DOT and the Nuclear Regulatory Commission and that the true strength of the transportation safety program lies in the shared responsibility and cooperation among Federal, State, and local partners. Although in the Nuclear Fuel Management and Disposal Act submitted to Congress in 2006 DOE proposed to preempt DOT's regulation of the transportation of radioactive materials in certain circumstances, FRA understands that DOE is not currently advocating for such legislation. Given the success of the current Federal regulatory system governing the transport of SNF/HLRW and the safety-critical aspects of such transportation, FRA would not support preemption of the comprehensive Federal regulatory process currently governing the transport of SNF/HLRW.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. HARRY REID TO EDWARD PRITCHARD

Question 1. In comments to the Surface Transportation Board, CSX recently expressed concern that the Department of Energy (DOE) is retreating from its commitment to use dedicated train service for shipping nuclear waste. The DOE apparently hasn't decided whether it will share its trains or its Nevada rail line with commercial carriers. Does the Federal Railroad Administration take a position about whether nuclear waste should be transported in dedicated train service? What are the risks of putting nuclear waste on the same trains as commercial freight?

Answer. In response to Congress's mandate in the Hazardous Materials Transportation Uniform Safety Act of 1990, the Federal Railroad Administration (FRA) studied the safety of using dedicated trains for the transportation of spent nuclear fuel (SNF) and high level radioactive waste (HLRW) as compared to other methods of rail transportation (*i.e.,* general consist trains transporting benign freight and/or other hazardous materials or "key trains" operating at maximum authorized speeds of 50 mph). A dedicated train is a train that consists only of equipment and lading associated with the transportation of SNF/HLRW. FRA's research concluded that given the comprehensive regulatory scheme applicable to the transportation of SNF and HLRW, the risk to employees and the public from such transportation is low to begin with, but on a comparative basis, use of dedicated trains would offer several advantages over general consist trains in the rail operating environment. For example, because by definition dedicated trains will be routed more directly to a destination, the trains will have shorter transit times than general consist trains. This shorter transit time reduces the probability of an SNF/HLRW cask being involved in a train accident and the potential hazards that can be associated with frequent yard stops (*e.g.,* increased dwell time and increased handling and switching

of the cars carrying the casks). The probability of a dedicated train being involved in an accident is further reduced by the decreased stopping distance of the shorter consist, as compared to general consist trains. In addition, use of dedicated trains would reduce the potential radiation exposure in any accident, as accident clearing can be expedited since the consist would be shorter than a general consist train, and since there are no other hazardous materials in the consist, there would be little chance of a fire that would prolong the response and accident clearing duration. Use of dedicated trains would also allow more flexibility to avoid higher-risk locations and to more easily impose operating restrictions such as lower operating speeds, as well as making it possible to further enhance the security of shipments of SNF/HLRW.

The risks of transporting SNF/HLRW in a general consist train are directly opposite to the advantages cited above. For example, a general consist train will generally be longer than a dedicated train and will not be routed to its end destination as directly and expeditiously as a dedicated train. Accordingly, the stopping distance of a general consist train will generally be longer than a dedicated train, the transit times will be increased, and a rail car transporting a cask in a general consist train will be more likely to be subject to additional handling and dwell time in railroad yards. If other hazardous materials are present in the train consist, there is an increased risk that in the event of an accident or incident that results in the breach of a hazardous materials packaging in the train (*e.g.,* a tank car containing a hazardous material), that other hazardous material could interact with or have an impact on the SNF/HLRW.

Given the clear advantages of utilizing dedicated trains as compared to general consist trains to transport SNF/HLRW by rail, FRA is currently conducting research to identify the train dynamics applicable to the configuration of dedicated train consists, as well as whether any additional specialized operational or mechanical measures should be implemented to ensure the safety of such operations. Based on the results of this research, FRA plans to initiate a rulemaking proceeding amending the Federal railroad safety regulations as necessary.

In a March 2005 report to Congress titled "Use of Dedicated Trains for Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel," FRA examined in further detail the relative safety of rail shipment alternatives for the transport of SNF and HLRW. A copy of that report can be accessed at: *http://www.fra.dot.gov/downloads/safety/report__dedicated__trains.pdf*.

Question 2. The DOE is not in the railroad business today. Do you believe that the DOE is prepared to not only build and operate the largest new rail line since the 1930s, but to launch a nationwide campaign to make thousands of shipments of nuclear waste?

Answer. Over the past 16 years, FRA has actively coordinated with the relevant offices of DOE on the infrastructure and planning issues that will need to be addressed to ensure the safe rail transportation of SNF/HLRW to Yucca Mountain. Most recently, DOE's Office of Logistics Management requested FRA's assistance in planning the proposed Nevada rail line. FRA has and will continue to work with that office, and other relevant DOE offices, to provide the necessary railroad-specific expertise and assistance to ensure that transportation of SNF/HLRW to Yucca Mountain will occur safely and securely. In addition, because as currently contemplated, SNF/HLRW will be transported to Yucca Mountain by commercial rail lines under contract to the Department of Energy (DOE), these operations will be required to comply with the DOT's comprehensive set of hazardous materials and rail safety regulations (49 CFR Parts 107, 171–180 and 49 CFR Parts 209–244). FRA will continue working with the DOE, all interested stakeholders, and when appropriate, the carriers responsible for transportation of the SNF/HLRW to Yucca Mountain to ensure that such transportation is conducted in the safest and most secure manner possible and in compliance with all applicable regulations.

Spent nuclear fuel shipments are a very minor portion of hazardous cargo movements by the rail industry. In 2006, all radioactive contents shipped by rail were only 0.5 percent of the overall hazardous material transported (AAR data). Spent nuclear fuel is a minor subset of the radioactive cargo. In this context, the challenge presented by these shipments is manageable.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. HARRY REID TO TED WILLKE

Question 1. How prepared are states today to deal with thousands of rail and truck shipments of nuclear waste? What additional steps must be taken to make emergency responders prepared to deal with a potential accident involving a radioactive release?

Answer. PHMSA recognizes the challenges the emergency response community faces in dealing with transport accidents involving spent nuclear fuel. In fact, one of our core goals is reaching out to emergency responders and hazardous materials stakeholders to ensure the preparedness and response communities are fully primed to deal with any type of hazardous material incident. PHMSA is prepared to provide its technical expertise to its Federal partners, the nuclear industry and State and local governments to ensure the transportation system remains safe.

While successful hazardous materials emergency preparedness programs exist, Congress has recognized additional effort will be needed when spent nuclear fuel is transported to a geologic repository. Accordingly, Section 180(c) of the Nuclear Waste Policy Act directs the Department of Energy (DOE) to provide technical and financial assistance to states and Indian tribes for training public safety officials in procedures for safe, routine transportation and emergency response situations. As transportation planning progresses, PHMSA will be prepared to work with DOE to apply its experience with existing emergency preparedness programs in developing a Yucca Mountain preparedness program. PHMSA also encourages DOE to conduct exercise programs to test and validate State, Tribal, and local officials' transportation emergency response plans.

Question 2. Given that Nevada will undergo shipments of nuclear waste from 43 other states if the Yucca Mountain project moves forward, why has Nevada received less Hazardous Materials Emergency Preparedness grant funding than all except for 9 states?

Answer. Hazardous Materials Emergency Preparedness (HMEP) planning and training grant funds are apportioned by formula. The grant allocation formula was developed by an interagency workgroup (which is now the National Response Team's training subcommittee) to distribute HMEP grants funds fairly and consistently to states, territories, and Indian tribes for addressing all hazardous material shipments. Spent nuclear fuel shipments are as very minor portion of the overall hazardous material shipment workload. To ensure a sufficient minimum level of planning funds for all grantees, a base amount is divided equally among all states and territories, and 3 percent of total planning funds are designated for Indian tribes. The remaining planning grant funds are apportioned according to the following risk related factors:

- One-fifth of the remaining funds are allocated to states and territories on the basis of their percentage of total population, with this measure serving as surrogate for risk to the general public.
- Two-fifths are allocated on the basis of a State's or Territory's percentage of total hazardous materials truck miles, a surrogate for highway hazmat risk.
- The final two-fifths are allocated on the basis of a State's or Territory's percentage of SARA 302 chemical facilities, a surrogate for fixed facility risk.

The base amounts plus the risk-related apportionments comprise the total training grant allocations to states and territories. As with planning funds, all but 3 percent of total training funds (the total training funds designated for Indian tribes) are apportioned on the basis of these risk-related factors:

- One-half on the basis of population.
- Three-tenths on the basis of total highway miles.
- Two-tenths on the basis of the number of fixed hazardous materials facilities that are identified by Census Bureau data.

In 2007, $12,800,000 was available for HMEP planning and training grants. Of this, Nevada received $123,592 using the allocation formula; an additional $98,130 was awarded to Indian tribes in Nevada. Taking this into account, Nevada ranked 21st out of 50 states for HMEP grant awards.

In 2008, $21,300,000 was available for HMEP planning and training grants. Of this, Nevada received $210,193, and $109,097 was awarded to Indian tribes in Nevada. In 2008, Nevada ranked 27th out of 50 states for HMEP grant awards.

Question 3. In 2007, the Department of Energy (DOE) officially gave Congress draft legislation that would abolish Department of Transportation's (DOT) authority over transportation of nuclear waste under the Hazardous Materials Authorization

Act. It would also preempt state and Indian tribes' transportation requirements. While there is no chance Congress will pass such sweeping authority to the DOE anytime soon, do you think DOT regulations and state regulations need to be preempted to facilitate a massive nuclear waste shipping campaign?

Answer. PHMSA believes that spent nuclear fuel can be safely and securely transported to a permanent repository under current law and PHMSA's existing hazardous materials transport safety program. The current regulatory program—based on uniform, federally-mandated safety controls and strong Federal-State partnerships for oversight and enforcement—has achieved an exemplary safety record for spent nuclear fuel movements over the past 50 years (1,500 shipments).

Question 4. The DOT requires that nuclear waste shipments avoid intermediate stops to avoid potential accidents and sabotage during stops. What role does or would the DOT play in the routing of nuclear waste shipments?

Answer. DOT has established Federal standards and guidelines for routing of nuclear waste shipments. Rail routes for radioactive materials shipments are determined by rail carriers, subject to Federal standards, including PHMSA's recent interim final rule requiring that carriers select routes posing the least overall safety and security risks. Under PHMSA's rule, beginning in 2009, rail carriers transporting highway route-controlled quantities of radioactive materials must analyze the safety and security risks along rail routes where such materials are transported, assess alternative routing options for those materials, and make routing decisions based on those assessments. Highway routing guidelines have been developed jointly by PHMSA and the Federal Motor Carrier Safety Administration. These guidelines are issued in DOT's publication "Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantity Shipments of Radioactive Materials." Briefly, these guidelines require carriers to follow "preferred" routes; prepare and file route plans; provide driver training; provide emergency response training and information; and follow security requirements. They also establish a methodology for determining how a "preferred" route is selected. The methodology includes the following: route identification and comparison criteria; criteria to evaluate radiation exposure to personnel and the environment; guidelines for assessing economic risk; emergency response evaluation methods; and general highway safety criteria.

Question 5. How would the DOT ensure that trucks hauling nuclear waste are safe during required stops, such as refueling?

Answer. The same robust design and construction features that make transportation casks safe across transport accident scenarios also limit their vulnerability to sabotage, theft, and diversion during transport. In addition to coordinating all shipments with states, Indian tribes, and Federal law enforcement agencies, DOE will have in place the following standards:

- Satellite tracking of shipments, with access to tracking information by appropriate Federal, State, and Tribal officials;
- Notification to relevant Governors and Tribal leaders before transport begins;
- Special safeguard procedures for the shipper to follow in emergencies;
- Escort training on threat recognition, response, and management;
- Advance arrangements with law enforcement agencies along the route;
- Armed escorts to accompany the shipment;
- Escorts to maintain visual surveillance of the shipment at all times;
- Status reporting by the escorts every 2 hours;
- The capability to immobilize the cab or cargo-carrying portion of the vehicle (for highway shipments); and
- Protection of specific information about any shipment.

Question 6. Out of 72 commercial sites with nuclear waste, one third of them do not have rail access. That means the DOE will have to haul waste by truck from these nuclear reactors either all the way to Nevada or to a railway. Does adding steps to the transportation process raise security or safety risks? Has the DOT approved this approach?

Answer. Coordination between the Federal Government and nuclear utilities will play an integral role in the planning and implementation of the transportation system. Transporting waste to the repository will begin at the utilities when they prepare transportation casks for DOE-managed shipment. As current owners of the fuel, the utilities have the responsibility of training their personnel appropriately to ensure the safe transfer of the waste to DOE, pursuant to DOT and NRC regulations.

It is our understanding that DOE will update both the nuclear site capability assessment data and the data on transportation infrastructure in the vicinity of sites that was collected in the early 1990s three to five years before shipments start. Site capability data identify the various operating capabilities at and around the utility sites that are important to determining cask requirements and site servicing needs. Transport infrastructure data provide information concerning the local transportation infrastructure that connects the utility sites with the nearest mainline rail or interstate highway system. Both data sets will be used to develop site-specific and final transportation requirements.

DOT's hazardous materials transport regulations prescribe safety controls providing an equivalent level of safety for all modes of transport and Federal security requirements apply equally across all modes of transport considered for spent nuclear fuel. Accordingly, hauling spent nuclear fuel from the reactor site to the nearest railway will not adversely impact its safe and secure transport. As DOE has not completed its transportation planning, PHMSA has not issued any transport or packaging approval or permit to DOE for the transport of commercial spent nuclear fuel.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DANIEL K. INOUYE TO KEN COOK

Question. What outstanding questions do you think need to be resolved before the shipment of nuclear waste to Yucca Mountain can begin?

Answer. Chairman Inouye, the crucial issues surrounding the safety and security of the transportation and storage of lethal, long-lived nuclear waste in the United States must meet the highest scientific standards of objective, rigorous analysis and transparency of process. Unfortunately, the rush to approve and build the proposed Yucca Mountain nuclear waste repository has not met these standards.

Since 2002, EWG has helped educate the public about the implications of nuclear waste, with a particular focus on the implications of transporting deadly radioactive wastes from nuclear power plants around the United States to Yucca Mountain, should the proposed nuclear waste repository there become operational. The American public's fundamental right to understand the full implications of shipping thousands of tons of extremely hazardous nuclear waste across this country should be central to the government's process for licensing Yucca Mountain, for operating any other repository for this material, and for all decisions to relicense existing reactors or build new ones. The Federal Government has not respected this right to know.

There are many examples of how government is violating people's right to know how the transportation of nuclear waste will affect them. The Department of Energy, the Nuclear Regulatory Commission and the Environmental Protection Agency have not implemented the safety and scientific recommendations of the National Academies of Sciences 1995 report *The Technical Basis for the Yucca Mountain Standard,* or of its February 2006 report *Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States.*

- EPA has not proposed or set a public health radiation safety standard that is protective of people at peak exposure.
- Both the Government Accountability Office and the Nuclear Waste Technical Review Board have questioned basic scientific and work produced by DOE, including its characterization of the physical and chemical characteristics of the proposed Yucca Mountain site and the effectiveness of proposed man-made barriers to the spread of lethal radiation.
- Addressed the security threats posed by the transportation of spent nuclear fuel.
- Planned for full scale physical testing of spent fuel transportation casks to determine basic safety issues, such as crash failure thresholds.

In addition, the foremost experts on Yucca Mountain have provided extensive detail as to why the proposed nuclear waste dump site is geologically unsuitable. (*See Yucca Mountain and the Nation's High-Level Nuclear Waste,* edited by Allison M. Macfarlane and Rodney C. Ewing, 2006.)

It makes no sense to generate tons more nuclear waste when we have not figured out what to do with the tens of thousands of tons already on hand. Our government has ignored that common sense precaution. Yet, the government is rushing to approve the license application for Yucca Mountain before rudimentary, life and death questions have been resolved about transportation, storage, and a truly protective

radiation safety standard. We should not burden our children and their children with unacceptable risks.

This result of the government's push to license the proposed Yucca Mountain nuclear waste dump and its subsidization of the nuclear industry while ignoring the public health, environmental and economic costs of these activities virtually guarantees that:

- Nuclear power plants would be transformed into long-term nuclear waste dumps. The recent surge in reactor relicensing ensures that hundreds of metric tons of extremely hazardous, high-level nuclear waste would remain in place at reactors around the country, as more waste is produced long after the proposed Yucca Mountain nuclear waste dump would be full.
- The proposed Yucca Mountain nuclear waste dump would have to be expanded or a second repository opened to accommodate the additional waste. By law, Yucca Mountain is limited to 70,000 metric tons of nuclear waste, which is almost equal to the amount of nuclear waste that will be stored on-site at reactors around the country in 2010, well before any repository could be opened.
- If rail were the primary means of transporting the waste, the security and health risks inherent in these shipments are enormous, and preparedness is minimal.
- The public would be unaware of, and unprepared for, the implications of policy decisions regarding nuclear power and nuclear waste and its transportation through its neighborhoods.

People of every state have a right to know and fully understand the implications for them of shipping nuclear waste to the Yucca Mountain nuclear waste repository before shipping begins or the license for the facility goes forward. And they have the same right to know what expansion of nuclear waste generation will mean for transportation through their state if reactors around the country are relicensed for 10 to 20 additional years of operation, or new reactors are constructed. They may or may not know that decisions made hundreds of miles away will have profound implications for the shipment of high-level, deadly nuclear waste through their neighborhoods for decades to come.

I thank you, Chairman Inouye, for the opportunity to answer your questions.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DANIEL K. INOUYE TO KEVIN CROWLEY

Question. Do you feel that the recommendations for the security and social challenges of transporting nuclear waste in your 2006 National Academy of Sciences report have been adequately addressed by the DOE, Department of Transportation, Department of Homeland Security, and the NRC?

Answer. To my knowledge, the Federal agencies have not addressed the recommendation in the National Academies 2006 report that an independent examination of the security of spent fuel and high-level waste be carried out prior to the commencement of large-quantity shipments to a Federal repository or to interim storage. The National Academies committee that made this recommendation wanted this independent examination to be carried out well in advance of the start of the transportation program so that steps could be taken to address any deficiencies that were identified. Otherwise, the initiation of the transportation program could be delayed.

DOE is taking important first steps to address the social challenges identified in our 2006 report. It is seeking advice from a social science expert and its external advisory group (Transportation External Coordination Working Group) on how to address the social challenges. This work is still in progress and it is too soon to judge whether it will be successful.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. HARRY REID TO KEVIN CROWLEY

Question 1. In your view, has the Department of Energy (DOE) adequately addressed recommendations from the Academy's 2006 report that they make public their "suite of preferred highway and rail routes for transporting nuclear waste" to support state, local and emergency responder preparedness? What would be the consequences of failing to engage state and local governments in routing nuclear waste shipments?

Answer. In my view, DOE is making good progress in addressing this recommendation by working with state, tribal, and local officials to develop a consultative process for selecting highway and rail routes for transporting nuclear waste to a geologic repository. This work is being carried out primarily through DOE's Transportation External Coordination Working Group. However, to my knowledge, DOE has not yet announced the specific routes that will be used to ship spent fuel and high-level waste to the repository should it be licensed and constructed.

It is important to consult with state, tribal, and local governments because these entities generally have better knowledge of local conditions, for example traffic and road conditions, that can affect the safety and security of shipments. Failure to consult with these governments could result in suboptimal route selections, loss of cooperation, and increased public resistance to shipping programs.

Question 2. The Academy has recommended that the DOE should ship older spent fuel before they ship newer, more radioactive fuel. Please describe the public safety and security benefits of this approach? Has the DOE ever indicated that they plan to follow this recommendation?

Answer. There are two primary benefits for shipping older fuel first. First, it would provide an additional margin of safety, especially for reducing radiation doses to transportation personnel who work in close proximity to the shipping casks (the casks do not shield all of the radiation emitted by the spent fuel contained within them). In the Environmental Impact Statement for Yucca Mountain, DOE estimated that some transportation workers would receive the maximum annual amount of radiation allowed by DOE occupational administrative limits during each of the 24 years of the transportation program. That limit is currently 20 millisieverts (2 rem) per year.

Second, shipping older fuel first would reduce the amount of radioactive material that could be released into the environment as a result of a severe accident or terrorist attack that breached the shipping cask. The risk of such releases is understood to be very small for severe accidents because of the robust construction of shipping casks. The National Academies has not undertaken a detailed assessment of transportation security and therefore cannot comment on the risks.

DOE has not indicated to the National Academies whether it intends to follow the recommendation to ship older fuel first. It is important to note, however, that under the requirements of the Nuclear Waste Policy Act DOE does not appear to have the legal authority to require spent fuel owners to offer their older fuel first for shipment. Consequently, if DOE decided to follow this recommendation it would probably have to negotiate with spent fuel owners.

Question 3. Would transportation risks be reduced if the United States were to store spent nuclear fuel onsite at nuclear reactors for several decades before shipping it? What is the best age for nuclear fuel for transporting it with the least risk?

Answer. Storing spent fuel onsite for several decades would reduce its radioactivity. Shipping lower-radioactivity fuel would likely reduce transportation risks, especially risks to transportation workers for the reasons noted in my response to the previous question. The risks would continue to decrease the longer the fuel was stored onsite. However, it is important to note that the risks of transporting spent fuel, or storing it onsite for that matter, will always be greater than zero.

It is interesting to note that if DOE ships older fuel first to the repository using its currently planned shipping schedule of 3,000 metric tons per year, most spent fuel will have been stored at plant sites for several decades before it is shipped to the repository.

Question 4. In the Academy's 2006 report, the Academy suggested that the DOE, U.S. Nuclear Regulatory Commission (NRC) and other agencies develop clear criteria for protecting sensitive information while making public less-sensitive information. Has information useful for community and emergency responder planning been made easily accessible?

Answer. The information that would be helpful to community and emergency responder planners include the following: the types and quantities of material being shipped, shipping route(s), and shipping schedules. Some general information on the types and quantities of materials to be shipped to a repository (if it is licensed and constructed) is publicly available in DOE's Environmental Impact Statement for Yucca Mountain. However, to my knowledge, DOE has not yet developed specific shipping plans that contain the level of detailed information that would be required for community and emergency responder planning. Some of this information is not normally released to the public until after shipments have been made for security reasons, so sharing this information with local communities could be problematic. Both DOE and Nuclear Regulatory Commission staff have expressed an interest in

improving the sharing of relevant information with state, tribal and local governments, but I do not know what specific progress has been made in this regard.

Question 5. What measures could the DOE and NRC take to improve the security and safety of nuclear waste transport? Has the DOE responded to the Academy's recommendation that an independent examination of the security of nuclear waste transportation be carried out?

Answer. The National Academies report entitled "Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States" made several recommendations for improving the safety and security of spent fuel transport. These were mentioned in my written testimony and include the following four recommendations:

> 1. An independent examination of the security of spent fuel and high-level waste should be carried out prior to the commencement of large-quantity shipments to a Federal repository or to interim storage. This examination should provide an integrated evaluation of the threat environment, the response of shipping packages to credible malevolent acts, and operational security requirements for protecting spent fuel and high-level waste while in transport. This examination should be carried out by a technically knowledgeable group that is independent of the government and free from institutional and financial conflicts of interest. This group should be given full access to the necessary classified documents and Safeguards Information to carry out this task. The findings and recommendations from this examination should be made available to the public to the fullest extent possible.

To my knowledge, DOE has not addressed this recommendation.

> 2. The Nuclear Regulatory Commission should undertake additional analyses of accident scenarios involving very long duration fire scenarios that bound expected real-world accident conditions and implement operational controls and restrictions on spent fuel and high-level waste shipments as necessary to reduce the chances that such conditions might be encountered in service.

Steps to address this recommendation have been taken by the Nuclear Regulatory Commission as noted in the testimony of Mr. Michael Weber.

> 3. DOE should ship spent fuel and high-level waste to the Federal repository by "mostly rail" using dedicated trains.

DOE's current plans for shipping to the repository are consistent with this recommendation.

> 4. DOE should negotiate with commercial spent fuel owners to ship older fuel first to a Federal repository or to Federal interim storage. Should these negotiations prove to be ineffective, Congress should consider legislative remedies. Within the context of its current contracts with commercial spent fuel owners, DOE should initiate transport to the Federal repository through a pilot program involving relatively short, logistically simple movements of older fuel from closed reactors to demonstrate its ability to carry out its responsibilities in a safe and operationally effective manner.

As described in my answer to a previous question, DOE has not indicated to the National Academies whether it intends to follow the recommendation to ship older fuel first. DOE also has not indicated whether it will initiate transport with the pilot program described above.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DANIEL K. INOUYE TO DR. JAMES DAVID BALLARD

Question. Your testimony contends that too many questions remain regarding the security of nuclear waste shipments. What areas need to be researched further in order to more fully understand the national security risks of transporting nuclear waste?

Answer. Thank you, Senator Inouye, I am happy to provide additional details on specific research projects that should be conducted prior to the commencement of any shipments to the proposed Yucca facility.

Besides the ten items noted in my written and oral testimony that were identified by stakeholders as needing to be addressed by the DOE and NRC prior to Yucca shipments, the Committee should also consider the following:

- First and foremost, what I believe is needed is a systematic analysis of realistic worse case attack scenarios and their consequences. These could emerge from

the AVA process I discussed in testimony. That process expertise already resides in a national laboratory environment—specifically Dr. Roger Johnson at Argonne National Laboratory. This analysis would offer usable scenarios, examples of which I tried to illustrate in my written testimony, which could be used as the basis of consequence analysis. It is critical that examples are not sanitized by the regulatory agencies that fail to look at such alternatives in their published analysis.

- Next I would suggest a National Academies of Science level assessment of 21st century terrorist motivations, tactics and weapons and their consequences/implications for radioactive shipment security and planning. Agencies seem to be approaching this problem from a Cold War mindset—perhaps we should consider not just that what will be shipped are 'waste' products but rather potential radiological dispersion devices that can be attacked and the contents dispersed into the environment. These materials need not be captured but rather we should consider how and if it can be used along the transportation routes as a means to attack this country, contaminate transportation infrastructure and other dire consequences.
- Once we have listed the worst cases and defined motivations for adversaries then we could make more useful comparisons between the proposed shelter-in-place strategy of leaving the waste at reactor sites in secure dry storage facilities and shipping the waste across country to a repository. This would also demand a full accounting of the transportation planning—as it is now the DOE has not defined the transportation system in enough detail to even allow for such an analysis. To meet that need you should consider requiring the DOE to engage in a national level transportation related NEPA process.
- Lastly, one immediate item that could be undertaken is a organizational level study of law enforcement and emergency responder awareness, capabilities and needs relative to the unprecedented high-level radioactive waste shipping campaign required for the Yucca Mountain program. No national level study exists on what these state and local agencies will need, what they have currently in terms of equipment and expertise, and what funding will be necessary in the future if Yucca shipments commence. It seems reasonable to establish a baseline now so that transportation planning and financial and technical assistance can assist in offsetting any funding impacts this proposed project would entail.

Thank you again for asking for the opportunity to testify before the Committee. If I can be of any additional service please do not hesitate to ask.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DANIEL K. INOUYE TO EDWARD R. HAMBERGER

Question. In your testimony, you expressed concern that the DOE has not yet committed to using dedicated train service for shipping nuclear waste on all routes across the Nation. Do you have any additional comments on why the DOE appears to be hesitating in requiring the use of these trains across your system?

Answer. AAR thinks that DOE should explain why it is hesitating.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. HARRY REID TO EDWARD R. HAMBERGER

Question 1. Will the AAR oppose the Department of Energy's (DOE) all-rail transportation plan for nuclear waste if they refuse to commit to dedicated train service?

Answer. AAR recognizes that because of the safety advantages afforded by rail transportation, rail is likely to be the preferred mode for transporting spent nuclear fuel. Even though DOE has not committed to dedicated train service, AAR is optimistic that, ultimately, DOE will decide to use dedicated train service because of its safety advantages, as discussed in my testimony.

Question 2. The DOE is not in the railroad business today. Do you believe that the DOE is prepared to not only build and operate the largest new rail line since the 1930s, but to launch a nationwide campaign to make thousands of shipments of nuclear waste?

Answer. There is no question it takes a high degree of expertise to build and operate a railroad. DOE, of course, can contract with railroad industry experts to build and operate the rail line.

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